SCIENTIFIC NEWS FOR General Readers

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CONTENTS.

SCIENTIFIC TABLE TALK.

By W. Mattieu Williams, F.R.A.S., F.C.S.

At the Southampton meeting of the British Association (1882) Schwedoft's theory of hail was brought forward by Prof. Sylvanus Thompson, and opposed by Sir William Thomson, who stated that a hailstone passing through our atmosphere would do as much work as would raise the water of which it is composed 13,000 centigrade degrees, or, otherwise stated, 13,000 times as much work as would raise it one degree. This being demonstrated mathematically, of course settles the question *mathematically.* To some people such demonstration is final, and therefore the idea that a lump of ice can enter our atmosphere as meteoric matter, pass through it and reach the earth as ice, is, as Sir W. Thomson said, "a manifest absurdity."

But we know that lumps of iron do thus enter the atmosphere, pass through it, and perpetrate the manifest absurdity by surviving in solid form this ordeal of fire.

In the case of iron the absurdity is even greater than that of water, as the *quantity* of heat demanded for the fusion of a given weight of iron is far greater than is demanded for the fusion and evaporation of the same weight of water. Note that we have here a question of *quantity* of heat corresponding to work done, not one of mere temperature.

The specific heat of water is nine times greater than that of iron, the quantity of heat demanded for raising a pound or any other weight-unit of water one degree will raise the same quantity of iron nine degrees, or nine times that quantity one degree. Therefore (assuming the figures of Sir W. Thompson to be correct) the heat generated as described would raise the iron nine times 33,000 degs., or 297,000 degs. But iron fuses at about 1,600° C. How, then, does it contrive to reach the earth in a solid state?

A simple experiment answers this question. Take a chisel or other hardened steel tool and press it against a rapidly rotating *dry* grindstone. Here work will be done in arresting the motion of the grindstone, and heat will be evolved in quantity exactly proportionate to the amount of mechanical motion arrested, *i.e.*, the motion of the grindstone. Both grindstone and steel will be heated; the temperature of the steel will be far higher than that of the grindstone because it is more concentrated on the smaller surface of the steel. The evidence of this high temperature will be supplied by the brilliant combustion of the particles of steel torn from the chisel, and by the softening of that part of the steel in contact with the grindstone. A chisel thus treated, as every practical workman knows, is spoiled by such softening, and therefore he always fits up his grindstone in a trough of water so that a film of cold water shall adhere to the rubbing surface. Itinerant grinders who sharpen other people's knives and scissors may omit this, as the softening of these is "good for trade;" the softened edges rapidly become blunt and require regrinding.

A further examination of the chisel, if fairly bright, will supply further instruction. It will show that the heat thus developed is generated at the surface whereon the force which did the work was applied. The well-known colours whereby the workman determines the temperature of heated steel will be displayed, the blue just beyond the ground face, then the purple, then the nut-brown and straw colour, etc. Two comparative experiments may be made, one in which the grinding operation lasts but a very short time, when it will be seen that the bands of colour will be very narrow; if in the other experiment the grinding be continued for a much longer time, the bands will be proportionately broader, showing that time be required for the heat to travel through the substance of the metal.

The case of the meteorite passing through the air is analogous, the air here representing the grindstone as regards its friction on the surface of the meteorite, which friction does the work of reducing the velocity of the motion of the mass. The effect is shown accordingly on the surface, as may be seen by an examination of the fine collection of specimens at the end of the mineral room of the British Museum (Natural History Department, South

Kensington). All of these are fused on their surfaces, but the work of the friction being completed in so short a time, the heat could not travel to the interior.

If so good a conductor as meteoric iron fails to carry the superficial heat to its interior, how much less able is so bad a conductor as ice to do the like. This may be easily illustrated by placing a lump of ice in the midst of a fire and watching the result. However fierce the fire may be, the time required for melting the ice is considerable, and proportionate to its size.

We must also remember that ice has the advantage of iron, not only in respect to specific heat, but also in that of its great latent heat of fusion and evaporation. Putting these together, those of my readers sufficiently interested in the subject may make the calculation for themselves, and will find that to melt and vaporize 1 lb. of ice demands about three times as much heat as to fuse 1 lb. of cast iron. Here, of course, I refer to the quantity of heat, or heat-work, not to mere intensity or temperature.

Besides this, Sir W. Thomson was wrong in assuming that all the work performed in retarding the motion of a meteorite, whether of ice or metal or any other substance, is directly converted into heat. It is evident that some of the motion of the solid body will be communicated to the air *as mechanical motion*; how much I will not attempt to calculate, but as the distance travelled in the mobile air is great, the amount of atmospheric commotion must be considerable. What may *finally* become of that motion does not affect the question under discussion, the hailstone being removed from the sphere of such action before it is completed.

I am aware that eminent men of science, whose views I am bound to respect, interpret the doctrine of the conservation of energy in such a manner as to assume that in every case where the mechanical motion of a body is arrested, *the whole mass* of the body is necessarily heated accordingly. I have discussed this question with scientific friends in literal table talk, and find that such discussion is instructive; it deals with one of the grandest, I may say the grandest, generalisation of modern science, the one which constitutes the philosophical basis of all our science, and which should be clearly understood by all.

I will therefore make it the topic of more table talk in this magazine.

THE THIRTY-SIX INCH TELESCOPE OF THE LICK OBSERVATORY.

MR. JAMES E. KEELER, one of the astronomers at the Lick Observatory, has recently communicated to the *Scientific American* an account of the great Lick telescope, from which we borrow the following particulars.

The pier of the telescope is a rectangular cast-iron column weighing 20 tons, built up of four sections rigidly bolted together. The thickness of the iron is about $1\frac{1}{4}$ inches. The lower section, which at the floor-level is 9 by 5 feet, expands into a broad base, 16 feet long and 10 feet wide, resting on the solid masonry foundation which forms the tomb of James Lick. This casting weighs 5 tons, and is the heaviest single piece hauled to the summit in the construction of the observatory. On top of the pier is a balcony, surrounding the massive head-piece which forms the support for the polar axis. The upper section of the pier, 4 by 8 feet at the top, contains the driving clock. A light iron spiral staircase, running from the base of the pier on the south to the balcony, gives access to the clock-room and n[illegible]y above, and adds greatly to the appearance of th[illegible]ing.

The weight of the pier is distributed over a number of heavy steel screws in the base, which afford means for the exact adjustment of the polar axis, but it is possible that, after this adjustment is perfected, the base will be set in cement, and the pier permanently fixed in position.

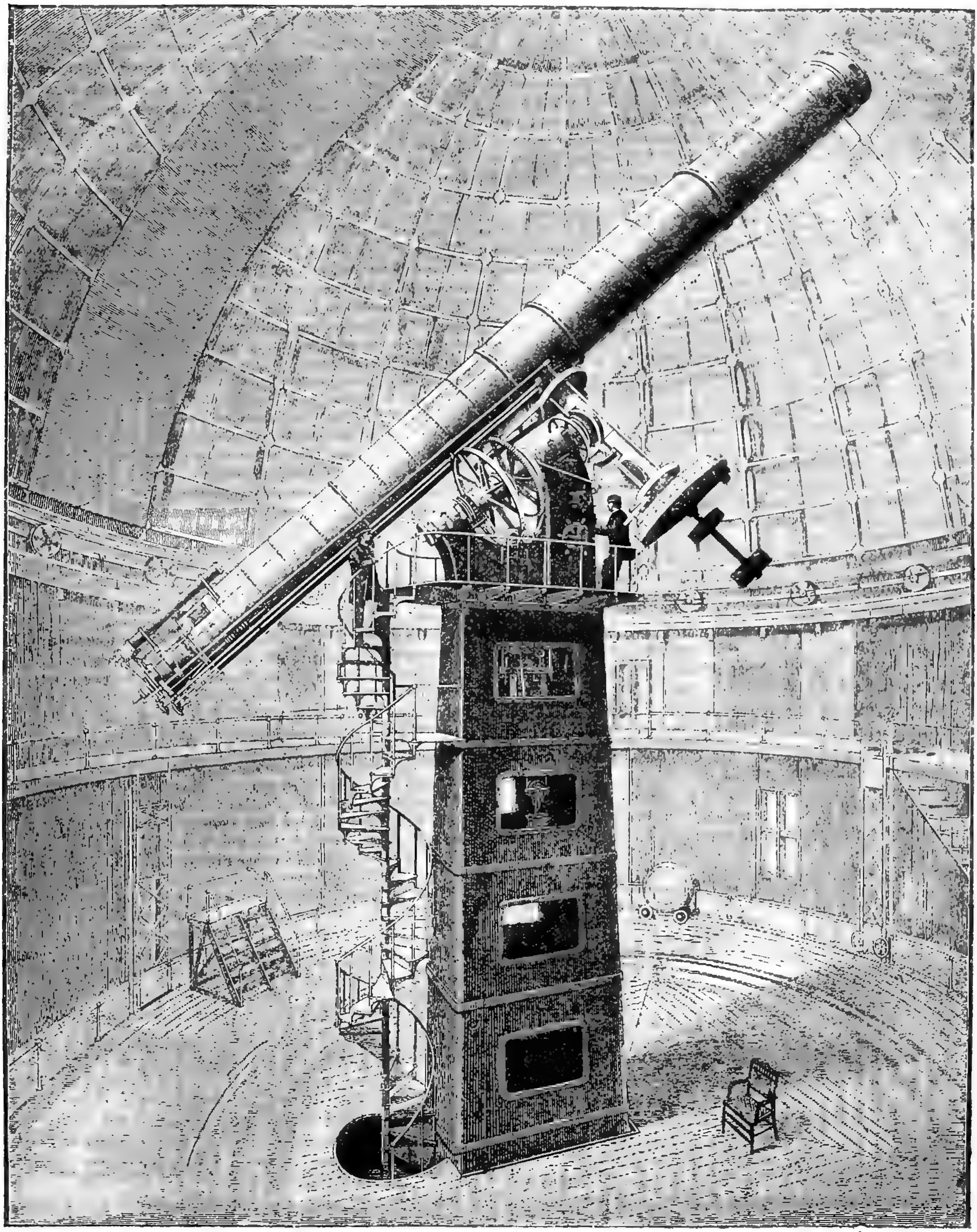
The telescope is intended to be moved by an assistant stationed on the balcony which surrounds the top of the pier.

The makers, Messrs. Warner and Swasey, designed the entire mounting, with the exception of the eye end, which was made essentially from plans prepared by Professors Langley and Holden. The telescope can also be moved quickly in the ordinary way by the observer at the eye end, although, as the whole train of gearing extending to the balcony must then be set in motion, this cannot be done as easily as if the quick motions had not been provided. A pressure of 10 lb. on the spokes of the quick motion wheel on the balcony will move the telescope in right ascension; a pressure of 20 lbs. is required for the motion in declination. The telescope can be reversed, or the same star brought into the field on opposite sides of the pier, in a little over two minutes.

The polar axis is a finely-finished shaft of steel, 12 inches in diameter and 10 feet long, weighing 2,800 lbs. It is pierced centrally by a 6-inch hole, through which passes a shaft for communicating the motions in declination to the telescope from the balcony. The polar axis turns in bearings of Babbitt metal, but the greater part of the weight on its upper end (some 14 tons) is supported by a collar containing hard steel rollers encircling the axis just outside of the upper bearing, and carried by a lever which leads down into the hollow head piece, and can be adjusted for tension. The lower end of the axis is turned to a flat surface, and the thrust of about 8 tons is taken by two rows of hard steel balls rolling in concentric grooves. To the upper end of the axis is bolted the cast iron cylindrical case, 9 feet in length, which contains the bearings of the declination axis.

The declination axis is 10 feet long and 10 inches in diameter, and is also made of steel. To one end is bolted the cast-iron central section of the telescope tube. The other end is just outside of the 6-foot declination coarse circle, and carries indices which point out the approximate declinations. The coarse circle is fixed to the declination axis case, and supports the rods which carry the weights for counterpoising the tube. This rod is made of a brass tube shrunk on to a steel core, and the weights, which are in the form of circular discs, travel on a thread cut in the brass. Each disc is 2 feet in diameter, and weighs 240 lb. Eight of these discs are required to counterpoise the telescope.

The bearing of the declination axis toward the telescope is relieved of the weight of the tube and its attachments (about $4\frac{1}{2}$ tons) by a double counterpoise lever, one end of which carries a collar with steel rollers, like that on the polar axis, the other an annular iron casting weighing 500 lb., which surrounds the sleeve of the declination axis just inside the coarse circle. The steel rollers embrace the axis close to the telescope tube, and as the counterpoise levers are always parallel to the axis, they relieve the same proportion of the pressure on the inner bearing in every position of the telescope.



TELESCOPE, LICK OBSERVATORY

The centre of motion of the telescope or intersection of the polar and declination axis is 37 feet 10 inches above the masonry foundation. The sight line of the telescope is $5\frac{1}{2}$ feet from the centre of motion, and the end of the rod for counterpoising the tube 12 feet.

The tube is made of hard steel plates rivetted together. It was shipped in four sections (besides the cast-iron central section), which are connected by bolts through flanges at their extremities. The plates near the middle of the tube are $\frac{3}{16}$ inch thick, and the thickness of the sheets diminishes towards the ends, where it is $\frac{1}{8}$ inch. The tube is 52 feet long, 4 feet in diameter in the middle, and tapers to a little over 3 feet at the ends. In the shops of the makers it was tested by placing a ton on each end when supported in the middle, and in other ways, the greatest deflection produced being about one-eighth of an inch.

The object-glass by Alvan Clark and Sons is secured to a flange on the outer end of the tube in the usual manner. Its clear aperture is 36 inches, and the distance of the focal plane from the back surface of the flint lens is 56 feet. The lenses are $6\frac{1}{2}$ inches apart, and the total thickness of glass, traversed by a ray of light, is about $2\frac{1}{4}$ inches. The weight of the objective in its cell is 530 lb.

The tail-piece at the eye end of the telescope is surrounded by a revolving jacket, provided with position circle, clamp, and slow-motion screws, for carrying the spectroscope and other accessory instruments. Clamps on opposite sides of the jacket receive two hollow brass rods 6 feet long and 3 inches in diameter, and any apparatus attached to these can be rotated easily and yet firmly about the axis of the telescope.

The draw tube at the eye end is 8 inches in diameter and is focussed by a wheel surrounding and concentric with the tube. This wheel acts upon three screws, parallel to the telescope axis, which move the draw tube in or out, and allow the heavy micrometer or other instrument to be adjusted to the proper focus with great ease and accuracy. The eye end is surrounded by a steel ring 39 inches in diameter to which lead all the clamps, slow motions, and other contrivances operated by the observer. The spokes of the right ascension wheels are notched, so that they can be distinguished from the declination wheels in the dark.

There are three finders of $2\frac{3}{4}$, 4, and 6 inches aperture, and in addition to these, brackets to which the objective and eye end of the 12-inch equatorial can be attached when a finder of great power is desired. The makers are providing a double slide micrometer eye-piece for this or the 6-in. finder, which will enable the great telescope to be pointed at a faint object by means of any neighbouring bright star—a contrivance especially valuable for photographic work.

The three microscopes for reading the finely-divided circles from the eye end (two for declination and one for right ascension) also pass through this ring. By turning a switch close to the eye-piece of the corresponding microscope, the circle to be read is illuminated by an incandescent electric lamp. Attached to the ring are also a small sidereal clock, a telegraph key for recording the time of an observation, and an electric switch for starting or stopping the driving clock.

The driving clock in the top section of the pier is, on a large scale, essentially the same as the clocks employed by Messrs. Warner and Swasey on their smaller equatorials and chronographs, except that it has an electric control, by which its rate is kept in agreement with that of a standard astronomical clock.

The equipment for photographic work is very complete. The photographic corrector is a meniscus of crown glass, 33 inches in clear aperture, and weighing in its cell 150 lb. When in use it is placed in front of the visual objective, and the focus of the combination thus formed is about 10 feet above the eye end. At this point a large aperture is cut in the telescope tube, giving access to a plate-holder capable of taking a dry plate 20 inches square, or any smaller size, and provided with all the necessary adjustments. An image of the moon formed here is about $5\frac{3}{8}$ ins. in diameter. Instead of a dry plate, a board holding an enlarging lens can be inserted in the plate-holder, and a magnified image of a planet projected into a small box camera, screwed to the draw tube at the eye end.

The steel dome, 75 feet 4 inches in diameter, was made by the Union Iron Works of San Francisco. The weight of its moving parts is 100 tons. It is rotated on the plan devised by Captain Floyd and Mr. Fraser, by an endless wire rope, which passes round the circumference of the dome, over grinding pulleys, and around a grooved wheel turned by a hydraulic motor in the basement. The dome can be turned completely around in nine minutes.

The slit for observing is $9\frac{1}{2}$ feet wide. It is closed by two steel shutters weighing 15 tons, which are opened by an endless rope hanging inside the upper gallery. A pull of 5 lb. is sufficient to move the shutters.

The hydraulic elevating floor weighs 26 tons, is $61\frac{1}{2}$ feet in diameter, and is movable between fixed galleries through a range of $16\frac{1}{2}$ feet. It is operated by four telescopic hydraulic rams, which have replaced the motors formerly employed for this purpose, their motion having been found inconveniently slow. The motors are retained, however, and can be connected in place of the rams whenever desired. By means of the rams the floor can be raised in a little less than ten minutes, and lowered in four, with an expenditure of 300 gallons of water. The floor is counterpoised by eight heavy blocks of iron, which slide in vertical columns and relieve the rams of all but two tons of the weight to be lifted.

PHOTOGRAPHY BY NIGHT WITH "LIGHTNING POWDER."

VARIOUS scientific journals and the special photographic organs have published formulæ for a mixture of magnesium and chlorate of potash, known as lightning powder, by means of which photographs may be taken in the night. We give, from *La Nature*, particulars of an improved process and apparatus devised by Mr. T. Sardnal, which prevents all risk of accidents, and obviates the escape of fumes from the burning powder. The inventor converts the powder into pastilles, which are then burnt in the apparatus shown in figs. 1 and 2.

The powder used is that of Dr. Fabre, and consists of:—

Pulverised chlorate of potash, very dry ..	6 parts
Sulphuret of antimony	1 part
Magnesium powder	3 parts

When these three materials are weighed out, the chlorate of potash and the sulphuret of antimony are very carefully mixed together, using for this purpose a slip of supple cardboard, or a *dry* finger. When the mixture is very intimate, the magnesium is added, and the whole is thrown upon a piece of coarse muslin of an open texture, placed upon a sheet of paper, upon which the powder may fall on shaking the muslin. When this operation has been repeated three or four times, the mixture is ready to be converted into pastilles in the following manner. The powder is placed upon a flat piece of glass, ordinary collodion is added enough to form a thin paste, which is mixed up with a wooden spatula or with the finger.

When the paste begins to set, it is at once formed into a flat pastille, and when half dry it is detached from the glass by passing beneath it the blade of a thin knife. It is then dried as quickly and perfectly as possible, since moisture would retard the combustion. The inventor has preserved such pastilles for two or three days by

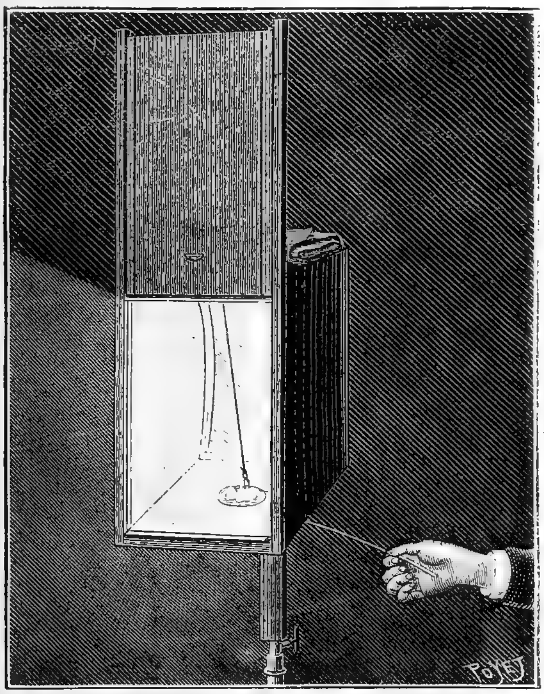


FIG. 1.

coating them with tin-foil paper, but he prefers to prepare each morning a quantity sufficient for use in the ensuing night. These pastilles have, as compared with the powder, the advantage of not scattering burning magnesium, and almost all the fumes remain shut up in the apparatus.

The following is the description of the apparatus in which the powder or pastilles should be burnt.

It is a box, placed vertically. The lid is replaced by a slide, and the bottom board by a plate of tin, sloped at 30° (fig. 1). In the middle of this tin plate there are pierced two small holes, to receive, the one a fuse of gun-cotton, and the other a nail which is introduced from below and which is twisted into a hook inside the box. The upper part of the box is partly removed, and this aperture is closed, at the moment of operating, with four folds of moistened linen. Lastly, the apparatus is lined with silver-paper, after the fashion of a passe-partout. To have a complete apparatus, it is merely necessary to mount the whole upon a sliding support, which can be raised or lowered at will (fig. 2).

After having focussed by means of candles, place the apparatus just described to the right or to the left of the camera, and so high that the light may fall upon the principal object at an angle of 15°. On the other side of the camera there is a small support set on a plate from which is suspended three or four ribbons of magnesium twisted together, and of a weight less, by fifteen times, than that of the magnesium powder employed in the apparatus. Care must be taken that the two foci are out of the field of the object-glass.

When these arrangements are made, the slide of the apparatus is fitted with a thread attached to the bottom of the trap, and which is fixed to the hook in the tin plate after having passed into another hook at the upper part of the box. There is then introduced through the other hole in the tin-plate a fuse of gun-cotton, the fibres of which are dusted over with the chlorate

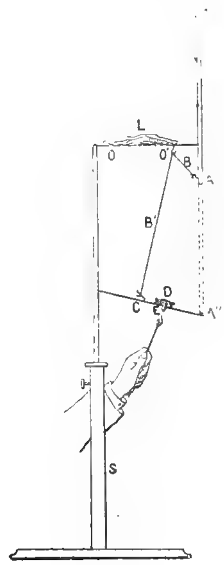


FIG 2.

and magnesium powder, and the pastille is placed upon it. The top of the box is then covered with the moistened linen, and the operation is commenced. The magnesium ribbons are ignited, the object-glass is quickly uncovered, and when the magnesium is almost consumed the wick of gun-cotton is kindled, taking care to keep behind the apparatus.

The pastille ignites and burns the thread which holds back the slide, but this takes place only when the explosion is complete, that is, after the explosion. At this instant the object-glass is closed, and the proof is developed as usual.

Fig. 1 shows the elevation of the apparatus, and fig. 2 the section. AA'A'' is the slide, BB' the thread serving to keep the slide raised, C hook to which the thread is attached, D the focus, E the fuse of gun-cotton, S the stand, L moistened linen placed over the openings OO.'

[It is essential that the chlorate of potash and the sulphuret of antimony should be powdered *separately*. Any attempt to pulverise them together, and even to mix them with mortar and pestle, would, in all probability, occasion a disastrous explosion.—ED., SCIENTIFIC NEWS.]

DIAMONDS FROM THE HEAVENS.

BETWEEN September 10 and 22, 1886, after the usual phenomena which accompany the arrival of meteorites, there fell three stones near the village of Nowo-Urei, in the government of Penza, in South-Eastern Russia. One of them was lost in a marsh; another was found by a peasant who, induced by a curious superstition, *ate* this wonderful substance arriving from heaven; the third was offered to the Mineralogical Cabinet of the Institute of Forests at St. Petersburg, where it has been carefully examined both mineralogically and chemically.

According to an account furnished to the Academy of Science by MM. Jerofeieff and Latchinoff, this stone, before being cut, weighed above four pounds. A part of its surface is remarkable for the deep piezoglypts which the mechanical action of the air has dug into it during its rapid flight. This surface is free from incrustation, as has been already observed in the case of several black meteorites, such as those of Tadjera. The fracture is almost black, but marked over with small particles, some of them white and others metallic. It is irregular and rough, but it does not present, as we find in many cases, a globular structure. Its specific gravity is 3·46.

By analysis it has been found that the meteorite of Nowo-Urei consists of fragments of peridote and pyroxene, between which is interposed a mixture of nickeliferous native iron and carbonaceous matter. There has also been recognised the presence of pyrrhotine and of chrome iron.

It will be understood that this is a mineralogical, not a chemical analysis, the ingredients mentioned being themselves complex.

The carbonaceous matter amounted to $2\frac{1}{4}$ per cent. of the entire stone. By successive treatment with aqua regia, hydrofluoric acid, and bisulphate of potash and by Brodie's process as adopted by Berthelot, it has been ascertained that the carbonaceous matter is a mixture of amorphous carbon and of diamond, perhaps of the variety known as carbonado, both in the state of microscopic grains.

The diamond has been recognised as such by its hardness, which is such as to eat rapidly into a polished surface of corundum which was rendered dull, and covered with fine scratches. The meaning of this test will be understood if we remember that corundum is, next to the diamond, the hardest substance known.

The mean specific gravity—of course, of the carbonaceous part—is close upon that of the diamond, 3·5.

When heated in a current of oxygen, the substance burnt yielding carbonic acid, and indicating a composition of 95·40 per cent. of carbon and 3·23 of ash.

In fine, the Russian mineralogists are led to conclude that the meteorite in question contains, in addition to 1·26 per cent. of amorphous carbon, diamond in the proportion of 1 per cent., but in very fine dust. The authors remark that, as the meteorite weighed 1,762 grammes, it contained 17·62 grammes of diamond, or 85·43 carats.

This discovery of diamond in a meteorite is not as unprecedented as it might seem at first sight.

The meteoric iron or holosiderite of Arva in Hungary is not only remarkable for its large proportion of phosphorus in the state of Schreibersite, a double phosphuret of iron and nickel, but also contains graphite in a cubic form. Hence Hardinger was of opinion that this crystal might be derived by pseudomorphosis, from iron pyrites, for which graphite had been substituted. But Gustav Rose remarked that these crystals present rather the form of the diamond, and that iron pyrites have never yet been recognised in meteoric stones.

M. Daubrée made the following remarks in addition:—In Brazil, the diamond in the sands in which it is sought for is accompanied by rutile, anatase, brookite, oligiste, tourmaline—that is to say an assemblage of fluoric and boric minerals, to the origin of which the diamond in this region seems to attach itself. In New South Wales, as Professor Liversidge has shown, the diamond is attended by the same minerals. Besides quartz, tourmaline is frequent along with brookite, ilmenite, topaz, corundum, and cassiterite (tin-stone), a mineral for which the intervention of the same fluoric or chloric agents is generally admitted.

In the important deposits of South Africa the diamond occurs in a very different manner, being associated with a serpentine brecchia in which the crystals are sometimes encased. But nothing shows that it has remained in its original matrix. It appears rather to have been torn away from the depths, and to have risen to the surface.

In the gangue of cosmic origin, which the meteorite of Nowo-Urei supplies, the diamond occurs in a manner different from the deposits on our globe. Its association with amorphous carbon is doubtless not accidental. Either the diamond, so refractory to the efforts of mineralogists for its artificial production, has separated itself by crystallisation from a carbonaceous medium, or, what is more probable, the diamond merely represents the residue of a partial transformation, which tends to change it completely into the state of graphite.

This last supposition seems particularly applicable to graphite in diamond-like forms, like that occurring in the meteoric iron of Arva. Seized and enclosed in a mass of iron, the high initial temperature of which is attested by the abundance of distinctly crystallised metallic phosphurets, it must necessarily lose its original state, and could not escape a change into the allotropic condition of graphite, with which we are experimentally familiar.

In the cosmic rock of Nowo-Urei the preservation of the diamond is surprising. It leads us to believe that the temperature of this rock, since the time when the diamond was developed, cannot have been very high, probably not reaching the melting point of peridote and pyroxene, in the midst of which it is found. Another proof is that nickeliferous iron could remain in the presence of free carbon without combining with it, as would probably have been the case at a high temperature.

Graphite abounds in meteorites, especially in Holosiderites, often isolated in nodules, as in the specimen from Arva, but more often in cylindrical cases around rods of pyrrhotine.

THE RELATIONS OF ASTRONOMY AND ASTROLOGY.—Professor Newcome (*Sidereal Messenger*) remarks that astronomy is often said to have been eagerly cultivated in the past because it served as a starting-point for the astrologers. But nothing in the writings of antiquity and of the middle ages supports this opinion. On the contrary, astrology must be regarded as an aberrant daughter of astronomy.

General Notes.

The Origin of Meteorites.—M. Faye seeks to revive the hypothesis of Lawrence Smith, according to which the meteorites are fragments hurled aloft by volcanoes in the moon and in the planets. *La Nature*, criticising this hypothesis, reminds its readers that meteorites very rarely present a volcanic character.

Baregine and Glairine.—These organised sulphur-compounds exert upon the sulphates of mineral waters a reductive action, the product of which is free sulphur. According to a recent communication of M. Olivier to the Academy of Sciences, these same organisms exhale ammonium sulphocyanide. In them sulphur seems to fulfil the ordinary chemical function of oxygen.

The Manufacture of Explosives.—The inspectors under the "Explosive Act" state in their annual report for 1887 that the number of accidents by explosion, and fires due to explosions in that year had been 130, causing forty-three deaths, and injury, more or less severe, to 105 persons. They mention as a serious fact, that a nest of young mice was found in a box of dynamite.

New Method of Embalming.—A certain Angelo Motta, of Cremona, invented, or thought he had invented, a process for preserving human bodies by gradually destroying the organic matter, and replacing it by metals. No possible good could result from the success of this process, and we may, therefore, rejoice that the inventor has carried his secret with him to the grave.

Royal Agricultural Society's Experiments at Woburn.—The annual excursion of members of the Royal Agricultural Society of England to the Woburn Experimental Farm took place on June 28th, when upwards of 100 gentlemen proceeded from Euston by a special saloon train, among those present being Lord Egerton of Tatton, the Earl of Macclesfield, Lord Middleton, Lord Northbourne, Sir J. Lawes, Dr. Gilbert, Sir John Shelley, Sir John Thorold, and Mr. Mark J. Stewart, M.P. At Woburn the party were met by Dr. Voelcker and Mr. Carruthers, who went over the various experiments and explained them.

Arsenic in Cretonne.—We publish in our correspondence column a letter from a well-known chemist, drawing attention to the use of arsenic in cretonnes and muslins, and we regret to learn that a draper in London has been compelled to return a large quantity of these materials to the manufacturer on account of cases of poisoning which have occurred. The use of arsenic in such materials is even more dangerous than in wall paper, and is strongly to be deprecated. We would advise our lady readers to be chary of buying bargains in these fabrics, unless a guarantee is given that they are free from this poison.

British Columbia.—The Rev. W. S. Green, who formed one of the expedition party for the recent deep sea explorations in the Atlantic, sailed on June 28th from Queenstown in the *City of Rome*, accompanied by the Rev. H. Swanzy, for New York. Their ultimate destination is British Columbia, where they are commissioned by the Royal Geographical Society to make a rough survey of the unexplored glacier regions of the Selkirk Range. The expedition will be assisted by the Canadian Pacific Railway Company. The two gentlemen are also commissioned by the Royal Dublin Society to collect information in the United States on the fish trade and fisheries, with a view to developing the home industry.

The Gramophone.—At a recent meeting of the Franklin Institute, Philadelphia, Mr. Emile Berliner, of Washington, read a paper on his lately invented apparatus for recording and reproducing musical sounds and speech, called the "gramophone." Mr. Berliner gave a historical sketch of the progress of invention in this field, and a detailed description of his own method and apparatus. He demonstrated its capabilities by recording on one of his prepared zinc plates several songs and speeches, etching the plate, and reproducing the songs and words then and there. Several etched record plates, prepared previous to the meeting, were likewise presented, and the reproducing apparatus faithfully emitted the songs and spoken words recorded upon them. The reproduction was loud enough to be distinctly audible all over the lecture-room. The music could be easily recognised. Speech, though not so clearly rendered, was for the most part intelligible.

Curious Cause of Action against a Medical Man.—An old Breton peasant, having met with a slight accident, sent for his doctor, who assured him that there was no serious injury and prescribed a draught, ordering at the same time leeches to be applied. As leeches were not easily procurable, the patient asked the doctor to get them for him. This he promised to do, and the next morning a bottle arrived containing half a dozen fine leeches. The farmer's wife being in doubt herself, applied to a neighbour for advice how to cook them. The result was that they were fried. The patient disliked the bitter taste of the first one so much that he declined eating any more. However, his wife insisted that as they had to pay for the "medicine," it ought to be taken, and so the poor man actually ate the whole of the fried leeches. He was afterwards seized with severe and fatal illness, which was attributed to poisoning by the leeches. The widow brought an action against the doctor, who, however, was exonerated from all blame by the court.

Compressed Gas.—It has been urged that the use of compressed gas for lighting cars is attended with the danger of the gas exploding in the event of a collision. The imaginary nature of this danger was shown by the recent accident on the Philadelphia and Reading, where an escape of compressed gas from a leaky hose simply burnt for a few moments without any explosion. Experience in Germany has been of a similar nature, and a recent collision near Birkenhead, England, between two trains lit with compressed gas, was unaccompanied by any explosion. At the time of the collision between the Hoylake and Mersey tunnel trains, the gas in the latter was alight. The gas cylinders of the smashed coaches were taken from the debris, and tested to a pressure of 150 lbs. per square inch, and they were found to be entirely uninjured beyond a few severe dents. The gas fittings of the remaining portion of both trains had not suffered in the least through the collision;

and, with the exception of those in the smashed cars, not a single lamp glass was broken in either train.

The University of Bologna.—On June 12th began the festivities in commemoration of the eighth centenary of the University of this name. *La Nature*, whilst admitting the impossibility of summing up all the illustrious men who have been connected with its history, makes an exception in favour of Galvani. The inauguration of a statute to his memory formed an interesting part of the festivities. On the proclamation of the "Cisalpine Republic" Galvani refused to take the oath of fealty to the new Constitution, and was deprived of his professorship. He died in 1798, without having been reinstated. It was at Bologna that the Ptolemean astronomy fought its last battle. Its most celebrated and most obstinate champion, the Jesuit Riccioli, occupied the mathematical chair at the University, and had published in 1651 a complete course of anti-Copernican astronomy in two bulky quartos. He had made some experiments on the fall of bodies from the top of the tower of Bologna, and believed that he had demonstrated the immobility of the earth.

The Life and Genius of Lavoisier.—By occasion of a new biography of Lavoisier, compiled by M. Edouard Grimaux, *Le Temps* pays an eloquent tribute to the memory of this illustrious savant, whose merits, we fear, are in these days not sufficiently estimated, even by a multitude of scientific men. The fact that he rendered chemistry quantitative by introducing the use of the balance should of itself be sufficient to cover his name with glory. We read here that when he became one of the "Fermiers Generaux," an occupation which cost him his life under the Reign of Terror, one of his colleagues in the Academy of Science exclaimed: "All the better! He will give us better dinners." It is to be regretted, however, that in the *éloge* in *Le Temps* there is no mention of Priestley as the first and true discoverer of oxygen, though he is duly credited with the discovery of other gases. It would have been both true and sufficient to have said that Lavoisier was the first to recognise the importance of oxygen, which Priestley utterly failed to do, and continued to advocate the phlogistic theory.

Observations on Saturn and Mars.—M. Perrotin informs the Academy of Sciences that he has examined the rings of Saturn at Nice with a magnifying power of 1,250 diameters. He has measured the distance from the margin of the ring to the body of the planet, and fixed the place, not merely of Cassini's division, but of the line which separates the bright rings from the dark enclosed ring. He finds that this dark ring, the existence of which has not been known for more than thirty years, presented an inner margin, not diffused, but perfectly distinct. M. Perrotin is continuing his studies on the planets which are at present in opposition, that is, in the most favourable position for observation. In Mars he has observed canals more vast than any of those previously mentioned. There are four which commence quite near the equator, and which extend to the white cap of the north pole. The region which recently seemed to have been inundated by the sea, judging from the greenish colour by which it had been overspread, seems about to resume its former continental condition, recognisable from the reddish colour which is gradually reappearing.

Liverpool Science Students' Association.—A large party of members and friends left on June 23rd for a field meeting at West Kirby and Hilbre Island. On arrival three sections were formed—a botanical party under the direction of Miss E. M. Wood and Mr. James MacKarell proceeding to Caldy; the biological and geological sections, under the guidance respectively of Messrs. William Narramore and I. E. George, making their way across the sands, first to the Little Eye, thence to Hilbre Island, for the study of the sandstone formations and interesting fauna of the happy hunting ground of local naturalists. The fine weather experienced proved highly favourable to the botanists, upwards of ninety-two plants in flower being obtained. Among the more interesting specimens found were *Thalictrum minus*, *Sedum Anglicum*, *Armeria maritima*, and *Ornithopus perpusillus*. The prize for the day was offered for the best-named collection of plants in flower belonging to the orders Compositae and Rosaceæ, and after a keen competition was awarded to Miss M. E. Clementson, who obtained twenty-two species. The geological features of the island were explained by Mr. Isaac E. George, who, in the course of his remarks on the peculiar "weathering" of the rocks, alluded to the great denudation that had taken place during the last century.

Aerial Voyages.—M. Faye writes to *La Paix* with reference to the projected expedition of M. Jovis (captain of the balloon *Horla*) from America to Europe. His remarks are suggested by a study of the more elevated atmospheric currents, in the midst of which tempests take their rise. "It is quite true that on setting out from a point like Caracas, situate in 10° north latitude on the northern coast of South America, and on rising very high into the air (about the region of the cirrus) there is the chance of meeting with a current flowing towards Europe. But these currents move at first very slowly, and only acquire a great speed more to the north, about lat. 20° or 25°. The voyage, in place of three days and three nights, will last at least ten or twelve days. Besides, these currents do not tend directly towards the northern coasts of Europe. From the parallel of 10° they move slowly westwards, declining more and more to the north. About 30° or 35°, according to the season, they move due northwards, then incline to the east, and finally take a north-easterly direction. Thus one of these currents, taken above Caracas will move first towards the Gulf of Mexico, enter upon the territory of the United States in Texas, leave the western continent at some point between Philadelphia and Newfoundland, cross the Atlantic obliquely, and arrive at the Bay of Biscay, the coasts of Ireland or of Norway. It is in these upper currents that cyclones are formed, a circumstance evidently dangerous for such a voyage. It would be better to select a starting point near New York, to enter into daily communication with the "signal service" and with the meteorological department of the *New York Herald*, and select, for, ascending, the moment when a depression, not dangerous, and well studied beforehand, was passing above the station. The voyage might then be completed in three or four days, and there would be at least the advantage that the departure of the *Horla* would be immediately telegraphed to all the European coasts. M. Faye, however, considers the undertaking rash, and advises its authors to weigh well the terrible risks to which they are exposed.

BUDS.

AMONG the many pleasing and wonderful effects of Spring, there is none more striking than the rapid expansion of buds into tender leaf. A few days of warmth causes them to swell and burst so suddenly that with many who have not thought about the matter their formation seems to be a thing of the moment. But, as will be presently shown, this is not so. Leaf and stem were there in the previous autumn, and indeed in a very rudimentary condition at an earlier period than that, and very little has been added to the organ besides water. In fact, buds may be made to develop into shoots with

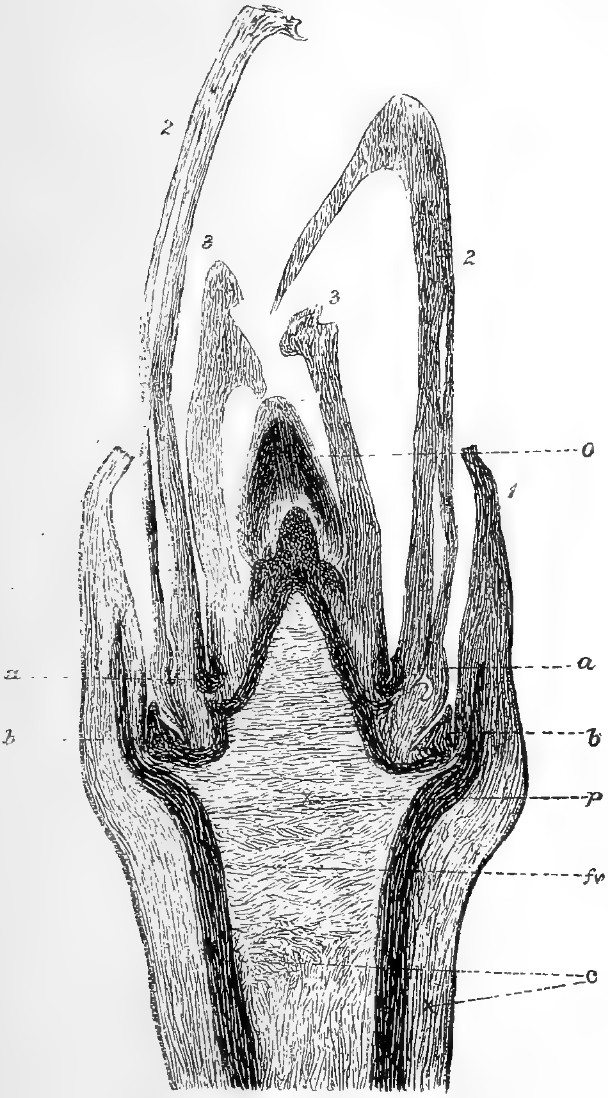


FIG. 1. SECTION OF LEAF BUD OF EUONYMUS.
a, *b*, axillary buds; *p*, pith; *fv*, fibro-vascular bundles; *c*, cortex, 1, 2, 3, young leaves. Magnified twenty times.

only warmth, water, and oxygen for respiration, care being taken in performing such an experiment to cut the branch bearing the buds under water, to render it more absorbent. It will contribute to a better comprehension of the matter if we imagine that we have before us a "winter-bud"—one from the spindle tree *(Euonymus)* will be a good example—which we have dissected through the middle, from base to apex. We shall then see a central axis tapering upwards from a thickish base to a fine point and along its sides a number of leaves, so closely set as to leave scarcely any interval, which tightly envelop the axis and overlap its tip, to which they act as a protection, but, it is important to note, do not, except in flower-buds, grow from it. This central axis afterwards becomes the stem, and the leaves which enwrap it will be noted to consist of two kinds, the inner or foliage-leaves, slightly succulent and light-green, the outer or scale-leaves dryish brown and often sticky and hairy. These latter usually fall away upon expansion, their function being the protection of the inner and more delicate parts. All these characters are visible to the naked eye, but if we now prepare a transparent section showing the same parts and place it under a low power of the microscope (or, in the absence of such, a good hand-lens will be helpful), we are able to make out the following important additional details. Proceeding as before, from the centre or axis, we observe first a lightish and, as a higher power shows, a cellular portion, which is the pith in a young condition, and this is bordered by two dark

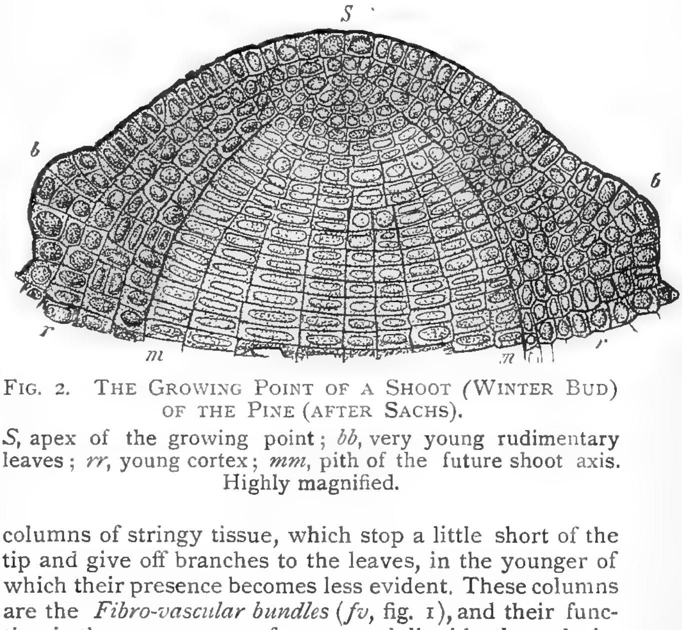


FIG. 2. THE GROWING POINT OF A SHOOT (WINTER BUD) OF THE PINE (AFTER SACHS).
S, apex of the growing point; *bb*, very young rudimentary leaves; *rr*, young cortex; *mm*, pith of the future shoot axis. Highly magnified.

columns of stringy tissue, which stop a little short of the tip and give off branches to the leaves, in the younger of which their presence becomes less evident. These columns are the *Fibro-vascular bundles* (*fv*, fig. 1), and their function is the conveyance of gases and liquids through the plant, and the maintenance of rigidity; they spread out into the leaves as the veins. External to these is another lighter cellular region (*c.*, fig. 1.), which is the bark in a young condition, and from it the leaves arise. The leaves (1, 2, 3, fig. 1) themselves are seen to be masses of cellular tissue, interrupted by strands of vascular tissue, and become smaller and less defined as they proceed towards the apex until they dwindle down to little roundish prominences on the upper part of the axis. But one of the most striking circumstances in connection with them is the existence in a very rudimentary condition (being less evident near the younger leaves) of next year's buds (*a*, *b*, fig. 1.), in the axils or angles which the leaves form with the stem. If we now raise the magnifying power to about 400 diameters, the vascular nature of the darker tissue and the cellular nature of the lighter will be rendered evident at once, whilst at their terminations the character of that most important part of the bud, the apex, or the *growing point* (fig 2), also becomes more clearly defined. It is seen to consist of cubical or polyhedral cells filled with protoplasmic matter of a solid or semi-fluid nature, and containing large nuclei which may be rendered more evident by staining with carmine. This is the most active part of the whole structure, and must be considered the beginning of the shoot rather than the end of it, as it is derived from the fertilized oosphere or single cell in the ovule of the mother-plant which gave rise to the present generation, and from its simple and but slightly differentiated condition has been formed all the complex structures of stem, leaf, and flower, its great activity being kept up by a continuous supply of nutriment from other parts of the plant. By way of illustration it may be mentioned that a similar mass of tissue is found close to the tip of every growing root and root-fibre, but here of course there is no bud.

(To be continued.)

POISONOUS DYESTUFFS.

A RECENT occurrence in Lyons has confirmed MM. Arloing and Cazeneuve's conclusions respecting the poisonous character of some aniline dyes and the harmlessness of others. Almost an epidemic happened last November with female spoolers working a particular yellow cotton yarn used for gold lace making. Dr. Carry, of the Lyons Medical Society, who was the first to notice the accidents, on being called to attend a spooler, found the patient suffering from a complication of obscure complaints. The most apparent symtoms were weakness, dyspepsia, and vomitings, coupled with a bluish-grey colouration of the gums, extending to the inside of the lips. As the yarn on winding emitted a considerable amount of yellow dust, and other working girls were similarly affected, the physician was soon on the right scent. He found that, while the accidents were caused by the dye, some yellows were very poisonous, others less so, and some quite harmless. One sort, giving out much dust, was so dangerous that one working girl had lost, within a short time, two canaries and one cat. The bird's cage hung near her machine, and the cat had probably swallowed the deadly dust with her food.

Next it was found that in a shop, where many girls were employed, no accidents were noticed last summer while the windows could be kept open, but the trouble began in November and December, when they had to be closed. With the new patients Dr. Carry had full opportunity to observe all the symptoms. Besides those already mentioned, which mostly relate to the digestive functions, others pertaining to the nervous system were noticed, such as persistent cephalalgia, insomnia, and an analgesis of the skin so complete that pin pricks could not be felt. At the same time the circulation was normal, there was no fever, and no albuminuria.

Some twelve or fifteen women were under treatment for the same complaint, and the recovery was in all cases very slow. But the accidents were too evidently caused by some poison to be thus dismissed without further investigation. Lead, the first that suggested itself, was looked for by a Lyons pharmacist, but proved absent. Three different specimens of dust were next given for thorough analysis to a specialist—Professor Pouchot, of the Martiniere school, who confirmed the absence of lead, but found traces of antimony used as a mordant.

The first specimen, the most poisonous, was found to have been dyed with sodium binitronaphthol, generally known in trade as Martius yellow; the second, less poisonous, with Poirier's light binitronaphthol; and the third, quite harmless, with the sodium salt of binitronaphthol sulphonic acid. Experiments on animals confirmed the chemist's report. Dr. Carry did not feel justified in concluding that goods thus dyed are dangerous to the wearers, but they are certainly to the weavers; and since yellows, equally good but harmless, can be obtained at a slightly higher cost, he thought the poisonous dyestuffs should be prohibited, or such ventilation enforced as to protect the working people from the dangerous dust.—*Therapeutic Gazette.*

THE CULTIVATION OF THE OSIER.

WITH reference to the judicious proposal of Mr. Mattieu Williams that the waste lands of this country should be re-forested, we lay before our readers some remarks on the cultivation of the osier in France, which have appeared in the *Echo Forestier* and in *La Nature.* The case is stronger in England than in France, for whilst France already exports osiers to a very considerable extent, both to Britain and to America, we do not produce sufficient for our own consumption.

There are in Europe not fewer than one hundred species of willows. Each of these species is well characterised from a botanical point of view, but for industrial purposes they may be divided into two sections, the respective types of which are the true osier (*Salix viminalis*) and the goat-willow (*Salix caprea*), the "*Saule marceau*" of the French. Both classes have a high importance in the art of basket-making, which is now a pursuit of importance. The coarse or brittle osier (*Salix fragilis*), sometimes known as the "crack willow," is grown to a great extent in France. It is planted along the streams and on the margins of marshy fields, and it is cut in pollards. The young shoots are reaped every year, and used for common baskets and hampers. Of this kind, as already intimated, France exports a large quantity. But of the fine osier used in ornamental basket-work, France does not produce sufficient for her home consumption, and imports it in large quantities from Germany and Italy.

We import this kind not so much in the twig as in the shape of manufactured articles. Now, there is certainly no good reason why the osier should not both be grown and worked up at home. Our climate is certainly not less favourable to its growth than that of any Continental country. It does not require great heat, but plenty of moisture, both in the soil and in the air.

The osier is a tall shrub, with upright long stems and very flexible branches of a greenish-grey colour, less commonly yellow. It prospers in soils which are too wet or too poor for most other crops, and it might, we think, be very appropriately planted to take up the moisture of sewage-irrigation fields. We have seen it, in fact, planted for this purpose at Leyton, where it seemed very flourishing. It grows rapidly, requires little attention, and by the third year (thirty-six months from the date of planting) it gives a net return, in the most suitable situations, of from £16 to £20 per acre; in soils of medium quality of £13 to £15; and in the worst and least suitable localities, £8 to £10. An osier bed, with due care, will continue productive for twenty-five to thirty years.

The expense of planting an osier bed may be as much as £9 or £10, and the annual cost £2 to £3 per acre. But it must be remembered that the land is generally suited for no other purpose, and is therefore, for the most part, lying waste.

Natural History.

A CURIOUS PARALLEL.

THERE must be few zoologists who have not been greatly struck by the manner in which types, so to speak, of structure are reproduced in groups of animals widely distant from one another. Thus we have beasts of prey, birds of prey, fishes of prey, and insects of prey; burrowing mammals, burrowing reptiles, burrowing insects, and burrowing crustaceans; swimming mammals, swimming birds, swimming reptiles, and swimming insects;

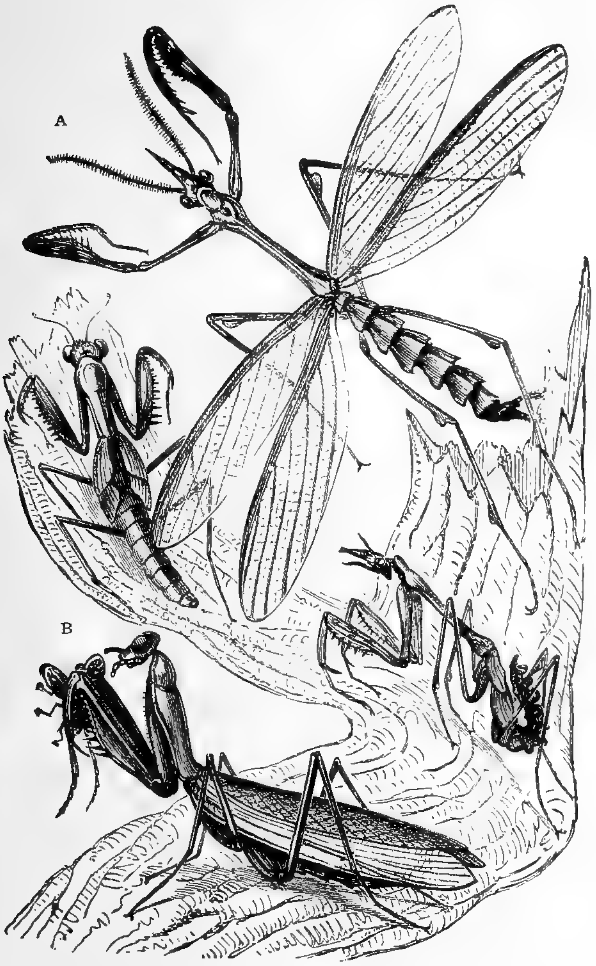


FIG. 1. A, *Mantis religiosa* and its larva. B, *Blepharis mendica* and its larva.

and similarity of habit implies similarity of structure, at any rate so far as general principles are concerned. And, very often, between individual species, though wide as the poles asunder in the scale of nature, we find the most startling similarity in bodily formation. Take, for instance, the mole and the mole-cricket. One is a vertebrate and the other an invertebrate; yet not even the most casual of observers can fail to notice the striking likeness which exists between them. Take, again, the whale and the fish: the similarity is so great that even now many of us find it almost impossible to believe that they do not belong to one and the same class of beings. And examples such as these might be multiplied *ad infinitum*. There is one very remarkable case of natural parallelism, however, with which very few of us are acquainted, and which is sufficiently remarkable to call for special notice; and that is the instance of the Praying Mantis and the Mantis Shrimp.

The former of these—a member of the vast class of the insects—is a fairly well-known creature. In some form or other—for there are many species—it abounds in all tropical and many temperate lands, and the curious attitude which it adopts while waiting for food, and which is referred to in its popular title, has rendered it familiar to many who would otherwise never have heard of its existence. This attitude, as most of us are no doubt aware, is very much that of prayer, the long fore-legs being clasped and raised aloft, as though in supplication to heaven. But, in reality, the insect is only holding those limbs in readiness for the fatal stroke to be delivered upon the first insect which ventures within reach; and, in order to understand the full utility of the

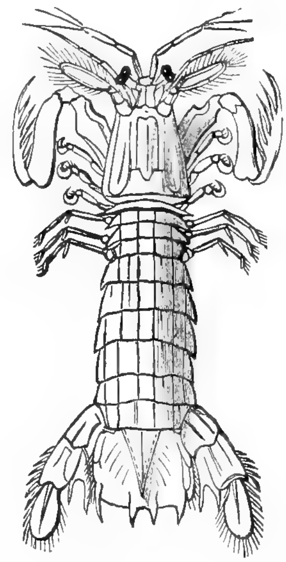


FIG. 2. The Mantis Shrimp. *Squilla mantis.*

position in question, we must examine the structure of the limbs.

In the first place, then, as may be seen by the illustration (fig. 1.), the *coxa*, or hip-joint, is greatly developed, and becomes not merely a joint—as in the generality of insects—but a veritable division of the limb, almost equal to the thigh in size, and furnished with an immensely powerful muscular system. The immediate effect of this prolongation, of course, is greatly to lengthen the limb, and at the same time to increase its power of folding. In the mantis from which this description is written, and which is a small one of its kind, the *coxa* is just three-quarters of an inch in length, while the thigh is one-eighth of an inch longer.

The thigh itself, which, like the *coxa*, is triangular, is armed upon its lower surface with two rows of strong and sharp teeth, one upon the outer edge and one upon the inner. In the specimen referred to the outer row consists of four tolerably large teeth, placed rather widely apart, and the inner of eighteen, varying in size, and situated quite closely together. The lower leg is also triangular, and is armed with a double row of teeth, the inner consisting of thirteen and the outer of ten, while the apex itself is developed into a very long, curved, almost fang-like claw, reminding one very much of that upon the tail of a scorpion, save and except that it is not perforated for the transmission of poison. The foot is quite small and insignificant, used in walking only, and never employed in the capture of prey.

These formidable limbs, as already mentioned, are raised high in air while their owner is lying in wait for prey. No sooner does a victim venture within reach, however, than they are thrown sharply forward and downward, and the insect, or whatever it may be, is seized between the thigh and the lower leg, the teeth upon which hold it securely imprisoned notwithstanding its struggles. The legs are then folded closely to the body, chiefly by the action of the *coxa*, the captive is brought into contact with the jaws, and there it is firmly held while its conqueror leisurely picks it to pieces and devours it.

The muscular system of these curious weapon-legs is exceedingly powerful, as is amply shown by the markedly triangular shape of every joint. And, as the lower part of the leg fits, when the limb is folded, into a groove upon the thigh, and as the teeth closely interlock, it is tolerably evident that a victim, when once seized, can have but very little hope of escape.

This structure is common to a large number of insects belonging to the group, whose slowness of foot is thus amply compensated for by the formidable character of their natural weapons. And their green colour and leaf-like appearance of course assist them very greatly, by assimilating them to their surroundings, and rendering their detection by their anticipated victims an almost total impossibility.

Now, in the mantis shrimp, strange to say, although a crustacean and a dweller in the water, we find a structure almost precisely similar in detail as well as in principle. And a most admirable illustration it supplies of the law that identity of habits produces identity of structure, even in creatures not in any way allied to one another, and existing under conditions of a totally different character.

Again we find the long raptorial fore-legs constituting weapons of offence, and armed, just as in the mantis, with a formidable array of strong and sharp spine-like teeth. Again we find the lower part of the limb fitting into a groove upon the upper, in order that the grip may be the more severe, the possibility that the victim should break away the less. And the chief, in fact the only, difference in the weapons of the two creatures is that in the crustacean the *coxa* is not prolonged, and that in consequence the teeth are set upon the foot; while it is the foot which is received into a groove upon the lower leg, and not the lower leg into a groove upon the thigh.

By those who have kept it in captivity, the mantis shrimp is said to use its raptorial limbs with wonderful address. Dr. Lukis, for example, speaking of his own specimen, tells us that "it placed itself in a menacing attitude, which would rather have excited the fear of exposing the hand to it. . . . . . I brought a silver tea-spoon near it, which was struck out of my hand with a suddenness and force comparable to an electric shock. This blow was effected by the large arms, which were closed and projected in an instant with the quickness of lightning."

In a smaller crustacean, also, popularly known as the Skeleton Screw, and scientifically as *Caprella linearis*, a very similar structure is found; but its efficiency is still further increased by a corresponding modification in the second pair of legs also, so that four raptorial organs are provided in the place of two. No groove is present upon the lower part of the leg, but that joint, which is enormously large, is armed with a double row of long and sharp teeth, between which the food is received, and which practically answer the same purpose. The foot itself, too, is sharply notched along the edge. And both attitude and action of the creature, when seeking for prey, are so singularly suggestive of those of the mantis, that it is quite difficult to realise that the two have absolutely nothing in common with one another.

Instances such as these are not uncommon, although seldom do we find the resemblance so complete in creatures so widely different. And yet, since the resemblance does exist, it is somewhat singular that the peculiar structure in question is not more common, seeing how great is the number of predacious beings, and how many of them, so far as we can tell, would benefit by the possession of raptorial limbs. Something similar we see in the water scorpion, the water gnat, and the stick-like *Ranatra linearis*, all of which capture their prey by the aid of modified fore limbs. But in none of these do we find the true mantis structure, which is so very pronounced in the creatures described. And we thus have a double and seemingly paradoxical source of wonder; firstly, that the similarity should exist at all, secondly, seeing that it does exist, that it is not far more common.

THE POISON OF BEES.—According to some investigations which Professor Carlet, of the Faculty of Sciences of Poitiers, has recently communicated to the Academy of Sciences at Paris, the poison-apparatus of bees comprises two quite distinct sets of glands, some yielding an alkaline secretion and others an acid product. For the full efficiency of the venom a mixture of the two liquids is required. The alkaline glands, which are highly developed in the bees and in all other Hymenoptera with a barbed sting, are merely rudimentary in insects of the same orders which use their stings not for defence against their enemies, but for paralysing a victim destined for the food of their larvæ. (If a bee is caused to sting into a piece of blue litmus paper, a red spot is produced, showing that the acid is in excess. The sting of a wasp, on the contrary, as it was first pointed out by Professor Church, and as we have since confirmed, has an alkaline reaction. It is very probable that all the animal venoms are of a complex nature. There is here evidently room for further research, which we recommend to persons in districts where the hornet is plentiful.—ED., SCIENTIFIC NEWS.)

APPLICATION OF SULPHATE OF COPPER TO FRUIT TREES. —M. Magny, President of the Horticultural Society of Coutance, writes to the National Horticultural Society of France as follows:—"Every year, about the months of February and March, when the fruit-buds on fruit-trees, of whatever species, begin to swell, birds (and especially bullfinches and tomtits) fall upon the fruit-trees and pick the buds to such an extent as greatly to compromise the hoped-for crop. Having in vain tried various methods, I had the idea last year of entirely covering my trees, especially the fruit-bearing branches, with the following composition:—4 lbs. of lime slaked in 6 pints of water, 1 lb. sulphate of copper (blue stone); dissolve in 67 pints of hot water, add then 1 lb. of soot and clay enough to give it a semi-fluid consistency. The result was good, as on all my trees, after being thus dressed, not a bud was damaged, and the blossom appeared in a normal manner. This composition has also the advantage of destroying the predatory insects which hibernate under the bark, and of preventing the spotting of the fruits by moulds and other fungi. The same mixture, with a little more sulphate of copper, has been employed against another enemy. All horticulturists know the decided taste of slugs and snails for nectarines (we may say for wall-fruit in general). In spite of hunting for them in the early morning, I had almost given up the hope of a crop, but now I have coated the walls, the stems, and branches of the trees with this composition, I have secured a full crop of sound nectarines." (We give this receipt on the responsibility of *La Nature*, but we consider it likely to prove both safe and effective.—EDITOR, SCIENTIFIC NEWS.)

AN ANOMALOUS MOVEMENT OF SWALLOWS.—The steamer *Abd-el-Kader*, which set out about the end of May from Marseilles, bound for Algiers, when at the distance of twenty-eight miles from land fell in with a large flight of swallows going *southwards*. They alighted upon all parts of the vessel, where they spent the night. At seven the next morning, when off the Balearic Islands, they left the steamer and all took flight in the direction of Algiers. A migration of swallows southwards at this season of the year has never before been witnessed. —*(Cosmos)*.

THE RAVAGES OF SILPHA OPACA.—This well-known carrion-feeding beetle has recently taken to prey on vegetable matter, and is indulging in the very pardonable freak of destroying the sugar-beet. Conjointly with this change in its diet it has begun to increase in a manner previously unknown. This prooceeding excites great wrath among the growers of betose, who are combating the enemy with sulphuret of carbon.

THE "CENTREING" OF THE HUMAN EYE.—Some years back Professor von Helmholtz showed that, optically speaking, the human eye was not a perfect instrument. M. Tscherning *(Comptes Rendus)*, who has re-examined the subject, finds that the adjustment of the eye is never exactly centred, but the deviation is generally inconsiderable. In most eyes the three centres are situate in the same vertical plane, but the centre of the cornea is below the axis of the crystalline lens. In other eyes the centre of the cornea lies in the same vertical plane as the axis of the crystalline lens.

OBSERVATION ON THE ARRIVAL OF THE SWALLOWS AT THE PARK OF BALEINE, IN L'ALLIER.—M. G de Rocquigny-Adanson gives in *Ciel et Terre* a table of the return of the swallows, from which it appears that the extreme dates over a term of forty-one years are from March 19th to April 11th. Half the returns took place between March 30th and April 3rd, the mean date being April 1st. The solitary, unusual date of March 19th, occurred after the severe winter 1879-1880.

BIRD MURDER.—As we learn, both from private sources and from contemporaries, the massacre both of hoopoes and of sand-grouse still continues. The possible penalties under the Wild Birds' Protection Act are ridiculously small.

POISONS IN THE WORKSHOP.

WE admit very generally that it is the duty, or at any rate the good policy, of the community to defend its members as far as possible from causes of disease or death. But we do not yet see that agencies which suddenly and swiftly strike down a man who might have previously been in robust health are, after all, less formidable than such as gradually undermine his vitality and enable him to leave behind an enfeebled posterity. We have yet to learn that the so-called "diseases of debility," phthisis, scrofula, albuminuria, affections of the brain and the heart, are as truly preventible as the various types of pestilence.

Among the causes of gradual decay and debility, we have at present to deal merely with the poisonous products employed in the arts and manufactures. We are too apt to connect the notion of poison exclusively with a sharp, sudden illness, ending in death, a *post-mortem* examination, and a coroner's inquest. But in the vast majority of instances there is no sudden death; the life of the victim is not so much shortened as rendered more or less useless and enjoyable. His strength fades away, he undergoes often extreme suffering without knowing the cause, and his death is finally attributed to some ordinary disease.

The number of poisons which enter into our industrial operations is great and increasing. We will accordingly take a glance at some of the most important, and consider how their evil action is to be avoided or overcome.

One of the most formidable, if its effects are viewed in connection with its trifling quantity, is mercury. The men engaged in mining for this valuable metal, and in separating it from the ore (generally cinnabar) often suffer severely. Among the ordinary effects are looseness and even entire loss of the teeth, and often formal salivation. Where it is constantly absorbed into the body in smaller proportions tremblings of the limbs, neuralgia, or other nervous symptoms are commonly observed. It is important to note that in proportion as the metallurgy of mercury has been improved by preventing the escape of the metal in the form of vapour, the health of the workmen has been greatly improved.

But much mischief is occasioned by mercury in the various arts in which it is employed. Probably the largest quantity is consumed in the so-called "amalgamation process," for separating gold and silver from their ores. In this process vapours of mercury are constantly given off, though not in striking quantity, and the men employed cannot entirely help coming in contact with the poisonous metal. The improvement devised by Mr. W. Crookes, F.R.S., *i.e.*, the use of an amalgam of mercury and sodium instead of pure mercury, has effected an improvement in this process from a sanitary point of view, since the quantity of mercury needed is reduced, and the time during which it has to be worked up with the ore is shortened.

The so-called silvering of mirrors is another extensive use of mercury, and is very detrimental to the health of those employed, the more so as the operation is not performed, like the amalgamation of gold and silver ores, in the open air, or in rough sheds readily traversed by the wind. The operation need not be here described in detail, but it consists substantially in applying to the glass, whilst in a horizontal position, sheets of smooth clean tinfoil, upon which a sufficient quantity of mercury is spread very evenly. This process requires careful manipulation; the hands of the men are often in contact with the metal, and the air is filled with mercurial fumes, which, it must be remembered, are given off even at the ordinary temperature of this country.

To do away with the evils resulting from this process, attempts have been made to "silver" mirrors with a thin film of pure silver deposited upon the glass, and thus entirely dispensing with the use of mercury. But these processes, though apparently successful, have disappeared from use. It is, indeed, rumoured that the inventors have been "bought off," lest the interests of the mercury trade should suffer loss.

A considerable quantity of mercury in the metallic state is used in the manufacture of thermometers, barometers, and hydrometers, in making Sprengel pumps, and in a variety of the operations of chemical and physical laboratories. For these purposes it is not likely to be superseded

Mercury is also employed in the preparation of vermilion, of corrosive sublimate, and of nitrate of mercury. The manufacture of vermilion and its use in the fine arts cannot be held injurious, since it is neither soluble nor capable of being volatilised at ordinary temperatures.

Nitrate of mercury is used to give hare and rabbit skins the power of felting. For this purpose it is dissolved in water, and brushed lightly over them with a sponge. In this process the hands of the workman are liable to absorb some of the poison.

The manufacture of corrosive sublimate without great care is very dangerous, as this compound may quickly prove fatal if inhaled in the state of vapour. Its use as a disinfectant also requires no little caution.

Antimony is one of the minor poisons from our present point of view. Its only manufacturing uses of any importance are in the preparation of so-called antimonial vermilion. This colour is less beautiful than the true, mercurial vermilion, but it finds a demand from its low price. Neither its preparation nor its use involves anything dangerous to health.

Of much more importance is the double tartrate of antimony and potash, commonly known as tartar-emetic. This substance was formerly employed only in medicine, but it is now used on a much larger scale, along with tannin, in fixing aniline dyes upon cotton wares. It has been often accused of producing irritation of the skin, and even erysipelas in persons wearing cottons which have been thus got up. It is, however, to be noted that men employed in the manufacture of tartar-emetic and in its use in dyeing and printing operations do not seem to suffer in the least. The same must be said of other preparations of antimony which have been tried as cheaper substitutes for tartar-emetic.

(To be continued.)

Reviews.

Betrieb der Galvanoplastik mit Dynamo-electrischen Maschinen zu Zwecken der Graphische Künste. Von Ottomar Volkmer. Vienna: A. Hartleben's Verlag.

This handbook, one of a series of technical works corresponding to the English series known as Weale's, relates to electrotyping as used in pictorial arts. It deals with the machinery used for eletrotyping, including gas engines and dynamos, the baths used, the solutions, and the methods of connecting them up and of regulating the current. We find descriptions of the installations in Vienna at the Imperial Institute of Military Geography, and at the Imperial printing establishment, of which latter the author is vice-director. The fourth section is really the most important in the book, as containing novel information, the rest being such as could be compiled from works already existing. It deals with the practical processes used for electrotyping, including the production of the original plate as a mould for electrotyping on, the deposition of electro-copies, the facing of these with steel or nickel or brass as a hardening process. The author next describes the processes of producing a plate fit for printing off, from non-metallic matrices, such as gelatine photo reliefs, wax and gutta-percha moulds, etc., and gives a detailed description of the production of the electro-plates from which the Government maps of Austria-Hungary are printed.

A descriptive list is given of the various chemicals and materials used by electrotypers, with their properties, tests for purity, etc.

It is a pity that in a book like this, intended to be written up to date, the author should have chosen for description those dynamos which are used in Austria-Hungary only, a rather antiquated Gramme machine, one by Schuckert, by no means his latest or best type; and one by Krötlinger, of Vienna, also containing no special features, when of late such very improved machines specially constructed for electrotyping have come into use. An illustration is given of a dissected Gramme ring, which at first looks like a very old friend, but we find that the author has substituted for the iron wire, of which the core is actually built, iron plates so placed that, in working, strong electric currents would be produced in them sufficient to damage the machine from over-heating.

In a chapter on the theory of the work done by electric currents, the author falls into a well-known fallacy in stating that "the maximum work is produced in the depositing baths when their conductor resistance is equal to the sum of the resistances of the source of supply (dynamo) and conducting wires." A dynamo of reasonable size would give its full output, absorbing only 10 or 15 per cent. of the total power internally, in which case the apparent resistance of the baths would be 8 or 9 times that of the machine, and by decreasing this resistance, to follow the author's rule, the dynamo would be carrying about 5 times the load it was constructed for, with results which can be imagined. Excepting, however, a few slips of this kind which are not peculiar to this work, we can certainly recommend this book as a practical guide to those engaged in any of the arts with which it deals.

A Manual of Orchidaceous Plants cultivated under Glass in Great Britain. Part III. *Dendrobium, Bulbophyllum, and Cirrhopetalum.* Chelsea: James Veitch and Sons, Royal Exotic Nursery.

The great genus Dendrobium possesses in the Eastern Hemisphere a rank and a varied development corresponding to those of Epidendrum in the Western Hemisphere. Each comprises a large number of species, and each displays the most gorgeous colouration.

The former genus, Dendrobium, has now been elevated to the rank of a sub-tribe, and includes the genera, Aporum, Rhizobium, Cadetia, Sarcopodium, Strongyle, Stachyobium, and Eudendrobium, the last being the most important.

Orchids of this group are found in south-eastern Asia, in the Malay Archipelago, Australia, and the islands of the Western Pacific outlying members occur in Southern India, Japan, and the Society Islands. An examination of the accompanying maps shows that the head-quarters of the Dendrobia are in Western Burma and in the Moulmein district. The eastern side of Australia, from the extreme north of Queensland, down to Cape Howe, is also fairly rich in species. New Guinea and Borneo are less abundantly supplied, having, probably, not been sufficiently explored.

Many of the species are so gorgeous that the careful descriptions here given, joined to the illustrations, fail to convey any adequate idea of their beauty. But many others, though botanically interesting, have no attractions for the horticulturists.

The closely-allied genus, Bulbophyllum, has also its principal seat in the Eastern Peninsula and the Malay Islands, but it spreads into Africa, and even South America.

One of the most remarkable species is the gigantic *Bulbophyllum beccarii* from Borneo. Its flowers emit so loathsome an odour as to exclude it from general cultivation. The function of this evil smell has not been ascertained.

Transactions of the Manchester Geological Society.—Vol. XIX., parts xviii. and xix.

Mr. Vaughan Cornish read a paper on the "artificial reproduction of minerals and rocks." Investigations of this kind have chiefly been conducted in France, and are important, not from the commercial value of the products obtained, but from the light which they throw on the natural formation of minerals.

Two communications "on the occurrence of boulders and pebbles in coal seams" were made by Mr. H. A. Woodward and Mr. W. S. Gresley, and were succeeded by a prolonged discussion. No theories in explanation of the presence of these masses were propounded differing in character from those mentioned in the SCIENTIFIC NEWS, p. 438. Mr. Wild, in the present discussion, suggested that the two theories of the formation of coal, viz., the drift theory and that of its growth *in situ* are not necessarily exclusive. "If a tract of country, 50 or 100 miles square, had a very rank vegetation upon it, and subsidence began to take place, say over the central half of that tract, water would begin to accumulate, trees there would cease to grow, and their remains would accumulate and decay, being augmented by the growth of mosses of low forms of moisture-loving vegetation. Streams flowing into this depressed area would bring in a lot of drifted vegetation, and a deposit would be formed, say 12 or 15 inches thick; then a flood might bring down a quantity of mud, which would be spread over the already formed deposit. Fresh growth or drift would again go on from the surrounding flattish land, and gradually there would be formed another deposit of moderately pure vegetable matter, which in course of years would be converted into coal." He considers that the boulders and pebbles have been liberated from some floating mass, such as ice or tree-roots, and let fall upon the submerged vegetable matter.

A curious fact mentioned is the occurrence of a water-worn pebble of lead-ore in a colliery in Shropshire.

In part xix., we find several papers on mine-rents and mineral royalties, of purely professional interest.

Abstracts of Papers, Lectures, etc.

MANCHESTER MICROSCOPICAL SOCIETY.

AT the meeting held on June 14th, the President, Professor A. Milnes Marshall, in the chair, Signor G. Platania, Acireale, Sicily, secretary of the Italian Microscopical Society, sent for distribution amongst the members a quantity of Tripoli, a fossil diatomaceous earth. Mr. W. Chaffers gave a short communication on Tripoli, explaining its character, and exhibited slides of the diatoms he had found after cleaning a small portion of the earth. The Society's annual volume was issued at this meeting.

At the February meeting of the Society Mr. Peter Cameron read a paper on Parthenogenesis in the Hive Bee, his object being to show that this doctrine, which has heretofore been accepted as correct, must at any rate be considered as open to question if not modification. Professor Marshall, who presided at that meeting, expressed a wish that some members of the Society would take the matter up.

Mr. E. H. Turner described the present position of an apiary, the owner of which, Mr. Tonge, had consented to make observations in this direction. Briefly the doctrine of parthenogenesis is this, that in some animals young are produced which are not the result of a sexual act, and in the case of bees that drones partake of the nature of the queen bee irrespective of the kind of drone by which she was fertilised. Consequently, if the doctrine be correct, such a thing as a hybrid drone is an impossibility. In the apiary in question a fertile Carniolan queen was introduced last summer, and from her it is intended to raise pure Carniolan queens, which will be placed in a hive of bees of the ordinary English type. Observations will be made as to the character of the young raised from her eggs. If the worker bees are hybrids, then if the doctrine of parthenogenesis be correct the drones ought to be pure Carniolan in spite of the fertilisation of the queen mother by an English bee.

An interesting discussion followed.

Professor Marshall made an interesting communication on Primitive Nervous Systems, illustrated by black-board drawings and preparation shown by means of the microscope. He defined a nervous system as a means of communication between one part of the body and another, and detailed the various uses which it served. Beginning with the Protozoa, the lowest forms of animal life, each individual consisting of a single cell, he took the Amœba as being typical of the group, and pointed out that although generally considered as being destitute of a nervous system, yet it possessed a certain amount of nervility or "nervousness," although no definite paths can be pointed out along which the impulses pass. In this case the whole surface of the animal is "nervous" as may be seen when examining an individual under the microscope. It moves by means of pseudopodia, long finger-like processes protruded from its protoplasmic body; and if it comes in contact with a foreign body, evidences of nervousness are given by its action. If the substance be good for food other pseudopodia are put out, and the animal slowly surrounds and absorbs it. If, however, the substance be unfit for food, the Amœba changes its course and passes it. Here we have the lowest form of nervous action. The nervous system follows the development of the other organs, and as we ascend in the scale of life the paths along which the impulses travel become more defined, and at the same time the results are quicker and more definite. In the Polyzoa (as illustrated by the Hydra) the sense organs are on the surface of the body, and are connected with the muscles in the interior. The outer cells of the Hydra are nervous, and are the most primitive form of a nervous system. The outer part of the cell is nervous and the inner part contractile, but there are no nerves, their place being taken by the medium part of the cell. The nervous cells are equally developed over the whole of the body, forming a nerve sheath, as from its habit the whole of the body of the Hydra is exposed equally to the environment. Where the parts of the animal are unequally exposed there is a variation in the development of the nerve cells. An example of this may be seen in the worms, where, from their habit of crawling on the ground, the nerve sheath is more fully developed on the ventral side. Turning to the Vertebrates he pointed out that in these the nerve sheath gives place to a localised nervous centre, the brain, from which nerves radiate to all parts of the body. He also described the development of the nervous system in the chick, and pointed out the important part the development of the nervous system plays in bearing out the recapitulation theory, in that, beginning as a single cell, it passes through the various conditions in which we find it in successive grades as we advance up the scale of life.

ROYAL SOCIETY.

At the meeting held on June 21st a paper on "Muscular Movements in Man, and their Evolution in the Infant: A Study of Movement in Man, and its Evolution, together with Inferences as to the Properties of Nerve-centres and their Modes of Action in expressing Thought," by Francis Warner, M.D., F.R.C.P., Physician to the London Hospital, and Lecturer on Botany in the London Hospital Medical College, was communicated by Professor J. Hutchinson, F.R.S.

Every one knows that children are fidgety, and babies smile, and crow, and move their thumbs and fingers. Many people do not know that seedling plants are also full of constant movement, but this has been demonstrated in plants of all the principal natural orders by Charles Darwin, in his "Movements of Plants." Dr. Francis Warner, while looking at infants, was struck with the fact that here, as in all other young living things, the parts are always moving in the young, but that older subjects present less movement. In fact, just as in the seedling it has been demonstrated that the constant spontaneous movements (circumnutation) result from healthful conditions of growth, and are succeeded by complex and highly important movements, such as bending to the light and away from the earth (heliotropism and apogeotropism), so in man this spontaneous movement becomes gradually co-ordinated and brought under the influence of surrounding forces, and the movements thus become so well fitted to the surroundings as to be considered useful, intelligent, and voluntary. The conditions of movement at ages from birth to ten years are described, and to do this much previous work on the part of the mother was needed. Dr. Warner has employed an apparatus which he invented (see author's "Anatomy of Movement") for recording movement of the child by lines on a revolving drum. It was also necessary to describe many kinds of movements and to classify them on physiological principles. The purpose in view in this study of spontaneous movements in infants is to report the first signs of the manifestation of mental faculty as seen when those movements are arrested or controlled by impressions made upon the child.

All expression of mind is by movements, and from observations made descriptions are given of the modes of action and properties of nerve-centres in adult age. Properties similar to those described in brain centres may be illustrated in modes of growth.

This part of his general work Dr. Warner illustrated in his work on "The Study of Nerve-Centres and Modes of Growth," which he delivered as Hunterian Professor of Physiology at the Royal College of Surgeons.

Graphic tracings were shown indicating the amount of spontaneous movement in an infant nine days old, and the controlability of such action in an older child by light and sound.

The author concluded by saying, "Intelligence is, then, not a property of the brain, *per se*, but for its manifestation certain modes of brain action are necessary.

LONDON MATHEMATICAL SOCIETY.

At the meeting held on June 14th, Sir J. Cockle, President, in the chair, the Vice-Chancellor of Cambridge University read a paper "On the Determination of the Circular Points at Infinity." Professor M. J. M. Hill followed with a paper "On the c and p Discriminants of Integrable Differential Equations of the First Order." Mr. Tucker (Hon. Sec.) communicated the following papers by Lord Rayleigh, "On Point-line and Plane-sources of Sound"; by Mr. H. Fortey, "Note on Rationalisation"; and by Prof. G. B. Mathews, "Applications of Elliptic Functions to the Theory of Twisted Quartics." Prof. Greenhill read a paper on "Coefficients of Induction and Capacity and Allied Problems." The following were taken as read:—"Electrical Oscillation," by Prof. J. J. Thomson, and a demonstration of the theorem that the equation $x^3 + y^3 + z^3 = o$ cannot be solved in integers, by Mr. J. R. Holt.

ROYAL METEOROLOGICAL SOCIETY.

The concluding meeting of this Society for the present session was held on the 20th ult., Dr. W. Marcet, F.R.S., President, in the chair.

The following papers were read:—

(1) "First Report of the Thunderstorm Committee." This report deals with the photographs of lightning flashes, some sixty in number, which have been received by the Society. From the evidence now obtained, it appears that lightning assumes various typical forms, under conditions which are at present unknown. The Committee consider that the lightning flashes may be arranged under the following types:—1. Stream; 2. Sinuous; 3. Ramified; 4. Meandering; 5. Beaded or chapletted; and 6. Ribbon lightning. In one of the photographs there is a *dark* flash of the same character as the bright flashes, but the Committee defer offering any explanation of the same until they get further examples of dark flashes. As the thunderstorm season is now coming on, the Committee propose to publish their report at once, along with some reproductions of the photographs by the autotype process, in order that observers may be prepared to notice the various forms of lightning.

(2) "The Cold Period from September, 1887, to May,

1888." By Mr. C. Harding, F.R. Met. Soc. The mean temperature for each of the nine months from September, 1887, to May, 1888, was below the average, whilst in the case of October there has been no corresponding month as cold during the last half century, and only three colder Aprils. In London the mean temperature for the period was only 42·4 degs., and there has been no similarly low mean for the corresponding period since 1854-5, which will be remembered as the time of the Crimean War, and only three equally cold periods during the last fifty years. The temperature of the soil at Greenwich at 3 feet below the surface was below the average in each month from October to April; in October and April the temperature at this depth was the coldest on record, observations being available for the last 42 years, and in November it was the coldest for 37 years.

(3) "Observations on Cloud Movements near the Equator; and on the General Character of the Weather in the 'Doldrums,'" by Hon. R. Abercromby, F.R.Met.Soc. The author gives the results of observations made during four voyages across the Equator and the "Doldrums," with special reference to the motion of clouds at various levels. Two voyages were across the Indian Ocean during the season of the north-west monsoon, and two across the Atlantic in the months of July and December. The nature of the general circulation of the atmosphere near the "Doldrums" is discussed as regards the theory that the trades, after meeting, rise and fall back on themselves; or, according to the suggestion of Maury, that the trades interlace and cross the Equator; or as following the analogy of Dr. Vettin's experiments on smoke. It is shown that the materials at present available are insufficient to form a definite conclusion, but details are given of the general character of the weather and of the squalls in the "Doldrums," with a view of showing what kind of observations are required to solve this important problem. The old idea of a deep trade—with a high opposite current flowing overhead—is certainly erroneous, for there is always a regular vertical succession of the upper currents as we ascend, according to the hemisphere.

HAWICK SCIENTIFIC AND PHILOSOPHICAL SOCIETY.

The annual general meeting of this Society was held on June 21st, the President (Mr. John W. Lamb) occupying the chair. The first session extends over sixteen months. During that time twenty papers, lectures, etc., had been brought before the Society. Excluding the President's introductory address on "The Constitution of the Matter," the first subject discussed was "Atmospheric Pressure," a paper on this subject, illustrated with experiments, having been read by Mr. Berry. Mr. W. E. Wilson gave the second physiographical paper on "Meteorology on Ben Nevis." Geology was represented by three papers, one by Mr. Rorrison on "Palæolithic Man," and two by Mr. Miles—viz., "Fossils, what they are and what they teach," and "Climate and Time." Astronomy was represented by Mr. Brown's paper on "Shooting Stars." Chemistry had its exponents in Mr. Dechan and Mr. W. C. Goodfellow, the former in a lecture on "Some Aspects of Modern Chemistry," and the latter in a paper on "Carbon Dioxide." Mathematics also received the attention of the Society, the subject being presented by Mr. Blackwood in his "Mathematical Treatment of the Rain Guage," and in a paper on "The Equation of Time." Botany was presented in a very attractive and interesting form by Mr. Robert Turnbull in a lecture on "The Fertilisation of Flowers" and "Insectivorous Plants." "Notes on the Moa Bird," illustrated with a femur of that gigantic biped, by Mr. Gowans, "Notes on some Shells from Pentland Firth" by Mr. Irving, and a paper on "The Hydra" by the President, were the contributions to the science of biology. Mr. James Jackson treated of "Musical Sounds," Mr. Thomas Welsh of "Vaccination," and Mr. W. S. Irving of "Soils, their classification and physical properties." Only two papers were, strictly speaking, philosophical, these being Mr. Sinclair's "Function of Reason" and the first of a promised series by Mr. Gowans on "Introduction to Psychology."

THE SOCIAL CONDITION OF THE BABYLONIANS.

Abstract of a Course of Lectures delivered by Mr. G. Bertin, M.R.A.S., at the British Museum. Third Lecture—Civil Life.

There was very little political life in ancient Babylonia, though the citizens had, to a certain extent, the direction of the private affairs of their own town or village. The municipal council, named by the most influential people of each town, was not to be envied, for in case of trouble the councillors, or the ancients, as they were called, had often to suffer for the conduct of the inhabitants. The absence of political life gave perhaps a greater impetus to the energy displayed by the Babylonians in their private undertakings.

On account of the fertility of the soil, agriculture was naturally the most important of the occupations of the Babylonians. As the great rivers of Mesopotamia do not overflow the country periodically, like the Nile, the agriculturists had to apply to the land an extensive system of irrigation. Canals were so important that an ancient king, Hammurabi, placed among the most important deeds of his reign, the construction of a canal. These irrigation canals were probably the property of the State or of the towns, and each agriculturist had to pay a fixed sum for so many hours, during which the water of the public canal was allowed to flow in his private canal; this mode of distributing the water for agricultural purposes, and of charging for it, is still practised in the East, and especially in Cyprus. When the ground was not level with the canal, a very rudimentary hydraulic apparatus was used to draw up the water, and pour it on the field.

There were several systems of land-tenure. In the first kind, called the double tenure, the landowner played the part of the sleeping partner, but he had to provide the farmer, or active partner, with implements beasts of burden, and seeds, and could claim half the crop for his share. The other tenures were called third, fourth, fifth, and sixth, from the proportion claimed by the landowner, and the smaller that share the less the landowner had to contribute to the expenses of the farm. The usual term of profit claimed by the landlord in the later period of the Babylonian Empire was ten per cent. of the crop; this answered to the ordinary letting. This system of tenure, and the custom of calculating from the crop and giving to the landlord a proportion of it, introduced the practice of paying in kind, which had sometimes a disastrous effect on the farmers. These were often obliged to borrow grain in the worst season to pay taxes, and had to repay, as is shown by many contracts, practically twice as much as they had borrowed. Some landowners cultivated their estate themselves by means of slaves, or their land was divided in small portions among a number of serfs, who had to give up the whole of the crop, keeping only enough for their bare existence.

The fertility of the land allowed the agriculturists to cultivate any kind of plants, the chief being that of the date-tree, for dates were such an important article that the word for date came to mean any kind of produce. Wheat, barley, oats were also cultivated, as well as several sorts of vegetables. Farmers also reared cattle, either as beasts of burden or to provide for butcher meat.

The geographical position of Babylon made it, at an early period, a great centre of commerce. The export and import trade was done either by caravan or by water. Goods were brought from the north on rafts, but, once in Babylon, the rafts were pulled to pieces and taken back on donkeys, or oxen, to the countries from whence they came, as it would have been difficult to go up the river against the current. The Babylonians never were good sailors; it is, therefore, probable that the sea-trade of the Persian Gulf was carried on by foreigners. The caravans radiated from Babylon in all directions, in Media, Elam, Assyria, and Armenia. The Syrian desert was avoided; as a rule, the merchants wishing to go to Syria and Egypt, went towards the north, crossed the Euphrates, turned southwards into Syria, and so into Egypt. The principal articles of export were grain, dates, cattle, and slaves, for the Babylonians were not manufacturers. The import, on the contrary, brought to the great city manufactured objects from Phœnicia: cloth, linen, carved ivory, and amber. Skins and hides were brought from Media and Armenia. Asia Minor was the principal country which provided horses for the Babylonians. We have several tablets of commercial agents informing their employer of the number of horses they had bought, and were sending from divers localities in Asia Minor.

When the goods were brought to Babylon, they were generally unloaded in the large markets held between the two walls, and sold wholesale to the small traders or commercial agents. There were many impediments to trade: tolls were numerous, not only on bridges, and through or near towns, but also near temples; the travelling merchant had besides to submit to the exaction of kings or governors through whose states he had to pass; but what he had most to dread was the highway robbers, and, in order to resist these, merchants often associated together, and travelled with a numerous, well-armed escort.

In some cases the merchant did not possess the necessary capital to buy the goods; he had then recourse to capitalists or bankers, who in that case played the same part of sleeping partner as the landowner in the double tenure, and received a certain percentage of the profit.

The retail trade was done on the same principle as the small land tenure. Large proprietors or capitalists had a number of shops which they farmed under certain conditions. Sometimes the owner merely placed in his shop a manager, who received from him all the goods, but had to give up all the profits, keeping only a fixed amount as his salary. Sometimes the shop was simply rented for a fixed sum; in other cases the landlord entered into partnership with the shop-keeper. The shops in Babylon were not like ours, with their great display of show-windows, but the goods were generally kept inside the houses, into which the customers had to enter to make their purchase. If people wanted to have more choice, they had to go to the bazaar, which answered to our retail markets; retailers there held stalls either on their own account, or in partnership with or as simple manager of the capitalist, who advanced the money to buy the goods. The articles sold in the bazaar were most varied: not only ornaments in gold, silver, amber, or ivory, but utensils of all sorts, clothing materials, and also eatables. The slave market was, it appears, held at a different place, as also was the horse and cattle market.

There was in Babylonia a branch of trade which hardly has its equivalent in modern time, that is that of the lender; it was an important and most lucrative industry. The lender let out on hire every possible article, tools to the workman, cart to the tradesman, horses, oxen, or grain to the agriculturist, or even furniture to people starting in life, but the most important article was the slaves: these were let for short or long periods as workmen of all kinds. We have in the British Museum several contracts referring to transactions of this sort, and it is generally specified that the hirer shall pay a fixed sum in case of death or disablement of the slave. The slave-owner did not always conduct a business of this kind himself: he often left it in the hands of a manager, who was sometimes himself a *galla*, or chief slave.

We see by that and by the same practice in other branches of commerce, that the middle-man was an important person in Babylon. Not only were there those employed as agents by the merchants, but there were also independent middle-men, who bought the goods in the wholesale market and sold them in small quantities to the retail dealers, and the independent agent who canvassed for the large slave-owners and lenders.

The profession of banker, money lender, and even usurer was generally in the hands of the scribes. In nearly every circumstance of life the Babylonian had recourse to the bankers: if a young man was on the point of being married he often borrowed in order to buy a house; in other cases a man borrowed money to create a capital and begin business, either by himself or in partnership with another. The money lender generally took as security houses or other landed property, or, like the modern pawnbroker, objects of value, rings, bracelets, etc.

Retail dealer and small agriculturist had often to appeal to the usurer, the former to buy the goods necessary to his trade, and the latter to buy either seeds or implements. The money was generally lent for a year or six months, repayable by monthly instalments at the interest of one-sixtieth per month, which is not so exorbitant for usurers. But when a man had borrowed, without giving any property as security, his creditor had claim on his person, and, as in ancient Rome, could seize his debtor and sell him as a slave.

Connected with trade is the interesting question of the means of exchange. There was no stamped money: the Babylonians used gold-dust, or bars of metal, gold or silver, weighed in scales; every article for sale was esteemed so much gold or silver in weight. Coined money appears to have been introduced by the Greeks at the time of Nabonidus; even the *darick*, so long supposed to have been invented by Darius, and its name derived from that of this king, is found mentioned in a tablet eighty years before his accession, and cannot, therefore, have been invented by him. The Babylonian name of this coin, *dariku*, is probably derived from the Greek *doru*, a lance, on account of its having on it the representation of an archer.

THE CHEMISTRY OF FIRE AND FIRE PREVENTION.

Abstract of a Lecture delivered by Mr. W. Lascelles-Scott, before the Balloon Society, on June 8th.

FIRE, or, to use a more appropriate term, combustion, is simply the result or accompaniment of chemical action, be it combination or the reverse, of so intense a kind that the substances immediately concerned are raised and maintained for a time at an exceedingly high temperature—the temperature of flame, or, popularly, that of a white heat.

"Combustion," however, may be very slow or extremely rapid according to circumstances, the former being well illustrated by the rusting, or oxidation of masses of iron, lead, zinc, etc., in the air, and the latter by the oxidation of the same metals when reduced to a state of fine division, as by powdering or filing, and then subjected to heat.

If a piece of sheet lead be scraped clean we know perfectly well that the surface will soon become dull again on account of the formation of a film of oxide thereon, and the same thing happens with iron, zinc, and many other substances; combination takes place with a little of the oxygen of the air (or of water, as the case may be), an oxide is formed, and "combustion" occurs. Of course the heat produced is quite inappreciable, but it is produced all the same, and we have only to accelerate the oxidation in order to render this quite evident. It is difficult to oxidise a bar of zinc or an iron rod with sufficient rapidity in the flame of a candle or spirit lamp to cause it to burn, because the heat communicated to any one particle of metal is conducted away by the mass so quickly that that particle does not rise to the temperature at which the oxidation can proceed with sufficient rapidity to produce light and heat. If, however, this cooling be prevented by exposing to heat and oxygen enormously increased surfaces of these same metals, with comparatively little mass, rapid oxidation, even to the extent of energetic combustion, takes place. This may be well shown by sifting iron filings into the flame of a spirit lamp.

This question of relative "surface" is worth a little more consideration; it is, of course, quite impossible that a block or sheet of bright metallic lead when exposed to the air should oxidise so quickly as to become heated to to the point of ignition, and the same remark applies to carbon or charcoal, but if either or both of these elements be so prepared as to exhibit, so to speak, an infinitely large surface and an infinitely small mass, exposure to oxygen, or even to air, at the normal temperature, causes immediate ignition of the whole. Phosphorus, again, when exposed to the air, at low temperatures, although it oxidises more quickly than the substances we have just been considering, seldom accumulates so much heat as to inflame; but by dissolving it in a certain manner and applying the solution to a porous substance—such as a bit of blotting paper, for instance—the menstruum would quickly evaporate and leave the phosphorus so minutely divided that the heat resulting from its rapid oxidation speedily causes it to burn. It is perhaps to such causes that some of the "suspicious fires" referred to lately by Mr. Peter McLagan are due.

The lecturer then referred to the modifications in the properties of bodies by the substitution of some other element or group of elements for one of the constituent elements of the compound, and instanced the case of cellulose and its three nitro-derivatives. He said nothing done in this direction had succeeded in making fabrics uninflammable, but it has long been known that by impregnating timber, textile fabrics, and other inflammable substances superficially, or throughout their substance, with certain chemical salts, they could be rendered less easy to burn, and a variety of salts have been recommended for this purpose. Hitherto these compounds have not proved very successful in practice. These chemical salts render canvas, muslin, etc., less inflammable in several ways dependent either upon the water they contain, the vapours they give off when heated, or the manner in which they surround the particles or encrust the fibres with incombustible mineral matter. As typical examples of salts of this kind he cited silicate of sodium (the so-called "water glass"), tungstate of sodium, phosphates and carbonates of sodium and ammonium, borax, and ordinary alum. Some of these—and particularly certain mixtures of two or more—give fairly good results—for a time. Then comes the reckoning. Mr. Scott said probably many of his audience had noticed that if a piece of damp linen be hung out of doors during a sharp frost it speedily gets stiff, and is so extremely brittle that it may be easily broken in pieces like a sheet of glass, or rather like the sheet of ice or crystallised water it really is. Well, something very like this happened when fabrics were impregnated with some of the chemical salts he had mentioned; if enough be used to make the stuff what is called fireproof, the salt is deposited in the pores and between the fibres of the material in the crystalline form. These tiny crystals have very sharp angles, and they act just as myriads of little knives or saws would do, speedily weakening the fabric and rendering it as brittle as the frozen linen mentioned before. Other varieties of these salts are prone to absorb moisture from the air, so that a lady's dress prepared with any of them, and got up, as the laundresses say, to be "very nice and stiff," would, in the course of a very few hours—the time varying with the material, and with the state of the weather—become quite limp and unwearable. Again, some salts are unsuitable by reason of their caustic properties, which, whether they be of the acid or of the alkaline class, tend to destroy the substance of the linen or cotton fabric, and to render it rotten. Many compounds of this class, even if giving apparently good results at the outset, develop acidity throughout the interstices, and, as it were, in the heart of the fabric, when a little time has elapsed. Increase of temperature greatly facilitates the decomposition of these salts, and enhances their destructive influences. Therefore in selecting a compound intended for the treatment of theatrical scenery or properties exceptional caution should be taken. In theatres and other places of public amusement the warmer regions are always near the top. In such hot places some salts—like phosphate of ammonium, and like common alum, as examples of a class—soon develop acidity, with the inevitable result that any fabric impregnated with them gets very tender after a time, and actually falls to pieces sooner or later.

In conclusion, Mr. Scott said: I believe I have made myself well acquainted with everything, or at least nearly everything which has been accomplished in the direction to which I refer, but until recently I knew of nothing actually in the market calculated to answer and to stand the practice and of time. I am, however, bringing under your notice a compound, of French invention, called "Ignifuge," which really seems to leave little or nothing to be desired. This compound has attained to something like a reputation in France, having been rewarded with a prize of 1,000 francs and a gold medal, after a series of exhaustive trials under a committee of experts appointed by the Prefecture. It is non-poisonous, does not destroy or even weaken any fabric impregnated with it, nor does it injure the colour of any dye of fairly good quality. Ignifuge will, however, render all kinds of fabrics and combustible materials absolutely incapable of sustaining flame

How is this accomplished? M. Martin, the inventor, does not really employ any one thing which is precisely novel, but he so mixes and combines two or more different fire-resisting salts that they neutralise each other's objections to a great extent. Further, by the employment of certain peculiar compounds of the salts with glycerine and lactic acid, all fear of their crystallising or efflorescing, on the one hand, or of becoming too moist on the other, seems to be avoided.

A number of experiments were then shown to prove the efficacy of the compound.

A discussion followed, in which the Chairman, Mr. F. D. Dixon-Hartland, M.P., Mr. P. McLagan, M.P., and others took part, and a committee—consisting of the above gentlemen, Mr. P. L. Simmonds, the Marquis de Leuville, Mr. Mr. W. J. Bull, Mr. Lewis Appleton, Captain Heath, Mr. W. H. Lefevre, M. A. Louis, and Mr. W. Lascelles-Scott—was appointed for the purpose of impressing upon Government the necessity of taking "prompt and improved measures to secure public safety and relief by increased numbers of fire escapes, relays of firemen, and other efficient means, and for the purpose of diffusing information and accurate knowledge respecting the prevention and extinction of fires and the safety of human life."

CORRESPONDENCE.

The Editor does not hold himself responsible for opinions expressed by his correspondents, nor can he take notice of anonymous communications. All letters must be accompanied by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

THE DURATION OF SUNSHINE.

A FACTOR of much interest has of late years been added to the science of meteorology by the introduction of the sunshine recorder, an instrument reflecting much credit to the inventor, although, as is usual, the first introduced, known as Campbell's burning recorder, was followed by Jordan's photographic. The first is simply a globe of glass of some three or four inches diameter, throwing a focus of the solar rays at about two inches from its surface, the focus being of sufficient power to burn through comparatively thick card paper; hence it may easily be conceived, if a strip of prepared card paper be made to encircle the globe at the right distance for the focus, and precisely opposite the path traversed by the solar orb in its daily journey, upon a clear day a small black line will be burnt along the strip of card paper; and, further, if the card paper be divided into hours and tenths, the number of hours of sunshine will be registered upon the paper for the day; after sunset the card paper can be removed from its proper receptacle and a new one inserted ready for the next day; such in outline is the instrument by which a measurement of the solar value is now being obtained in many parts of the kingdom. At Eastbourne one of these instruments completed its first three years' work on the 31st of May last, having been set to work on the 1st of June, 1885. The record thus obtained is bringing to light many features of considerable interest independent of the record of the actual number of hours registered, the most important being its testimony in favour of there being in every month of the year, certain days that are annually bright and sunny, and others that appear annually to be nearly or quite sunless; holding out to us the hope that in future we may be empowered to select our sunny days for picnics or holidays, and avoid the more cheerless ones. Again there are other days that appear to be bright and clear in the morning but cloudy during the afternoon, others wherein the solar orb shines forth during the middle of the day only, and others wherein the afternoon is reserved for solar favours. Indeed, the facts of interest that reveal themselves at every step are many and various, clearly showing this branch of meteorologic science will, in the near future, form by no means the least interesting.

In the following table is embodied the five most sunny, and the five most sunless days for each month of the year, as revealed from a three years' daily average:—

JANUARY.

Most Sunny Days.		Least Sunny Days.	
26th	6·1 hours.	31st	0·0 hours.
28th	5·6 "	22nd	0·0 "
17th	5·0 "	15th	0·0 "
20th	4·7 "	11th	0·0 "
30th	4·3 "	4th	0·0 "

Total for the month, 66·6.

FEBRUARY.

26th	6·5 hours.	21st	0·5 hours.
10th	4·5 "	11th	0·3 "
2nd	4·3 "	19th	0·2 "
27th	4·2 "	3rd	0·1 "
28th	4·1 "	29th	0·0 "

Total for the month, 65·0.

MARCH.

7th	6·2 hours.	5th	1·9 hours.
29th	6·0 "	3rd	1·8 "
6th	5·2 "	17th	1·4 "
2nd	5·0 "	18th	1·0 "
9th	4·7 "	27th	0·9 "

Total for the month, 105·0.

APRIL.

26th	10·0 hours.	15th	3·3 hours.
21st	9·3 "	14th	3·3 "
3rd	8·8 "	2nd	3.2 "
20th	8.5 "	7th	1·9 "
27th	8.3 "	29th	0·5 "

Total for the month, 169·0.

MAY.

15th	13·0 hours.	25th	4·7 hours.
9th	11·1 "	11th	4·6 "
14th	10·4 "	17th	3·8 "
5th	9·3 "	19th	2·0 "
20th	9·2 "	16th	1·0 "

Total for the month, 216·0.

JUNE.

10th	12·0 hours.	6th	4·6 hours.
11th	11·3 "	2nd	4·2 "
12th	10·3 "	3rd	4·2 "
28th	10·0 "	26th	3·8 "
20th	9·5 "	8th	2·7 "

Total for the month, 224·3.

JULY.

6th	14·0 hours.	19th	5·6 hours.
3rd	12·9 "	31st	5·6 "
22nd	12·2 "	25th	5·4 "
1st	12·2 "	30th	4·3 "
4th	11·0 "	12th	1·4 "

Total for the month, 263·3.

AUGUST.

Most Sunny Days.		Least Sunny Days.	
15th	10·8 hours.	26th	4·0 hours.
25th	9·6 "	18th	2·3 "
22nd	9·2 "	19th	2·2 "
10th	9·0 "	28th	1·9 "
6th	8·9 "	7th	1·3 "

Total for the month, 199·7.

SEPTEMBER.

8th	9·1 hours.	25th	2·1 hours.
1st	7·9 "	12th	1.3 "
18th	7·5 "	2nd	0·9 "
3rd	7·3 "	11th	0·8 "
6th	7·3 "	30th	0·6 "

Total for the month, 143·3.

OCTOBER.

11th	5·5 hours.	6th	2·0 hours.
1st	5·4 "	27th	2·0 "
25th	5·3 "	30th	2·0 "
16th	4·4 "	31st	1·2 "
21st	4.3 "	23rd	0·6 "

Total for the month, 101·0.

NOVEMBER.

16th	5·4 hours.	11th	0·1 hours.
17th	4·8 "	9th	0·0 "
6th	3·7 "	10th	0·0 "
15th	3·4 "	13th	0·0 "
1st	3·5 "	26th	0·0 "

Total for the month, 55·0.

DECEMBER.

1st	4·1 hours.	24th	0·6 hours.
25th	3·7 "	4th	0·4 "
7th	3·5 "	17th	0·2 "
27th	3·5 "	13th	0·0 "
30th	3·4 "	21st	0·0 "

Total for the month, 59·2.

Herein therefore, it appears the 6th of July is the most sunny day of the whole year; the month of July likewise registers more sunshine than any other month, but this is not the case at many other places in the kingdom; as might be expected, the month of November registers the least.

Among the singular facts revealed throughout the year is the apparent partiality of the solar orb to shed forth his favours at certain periods of the day. Take, for example, both the 27th and 28th of January; on each of the three years upon these days the sun commenced to shine about 8.30 a.m., and shone on brilliantly till 1 p.m. Precisely the same is observed on the 26th of February, with the exception that the sun commenced to shine each year precisely at 8 a.m.; whilst on the 15th of March each year the sun commenced to shine between 11 a.m. and noon, and afternoon became the chief recipient of solar favours. April furnishes a day, the 16th, when solar favours are abundant between the hours of 9 a.m. and 3 p.m. May contributed two splendid days, the 14th and 15th, when each year the sun commenced to shine before 6 a.m., and shone on without a break till close upon 7 p.m. Can this be chance or periodic? June had the honour of contributing the greatest amount of sunshine in one single day, this being the 13th of June, 1887, when no less than 15½ hours of sunshine was registered. July, the month *par excellence* for sunshine, yet presented us with one day, the 12th, whereon only at rare intervals in either year did the solar orb shed upon us his gladdening rays for a few minutes; on many a November day the sun has been quite prodigal of his favours compared with this singular July day. August presented us with a lovely afternoon on the 9th, with a bright morning and afternoon but cloudy midday on the 21st, and with a cloudy morning and afternoon but bright sunny midday on the 26th. September presented the least number of singular days of any month, but on the 12th we find between 7 and 9 a.m. is always a sunny period, the rest of the day, except between 2 and 3 p.m., is dull and cloudy. October entered with a lovely sunny day, and again solar favours are abundant on the 11th, upon this latter date between the hours of 9 a.m. and noon, not a cloud passed over the sun during either year. November is the first month of the year presenting us with sunless days, commencing with the 8th and 10th; thus we find both sunny days and sunless days, like birds of a feather, flock together. The last sunless day of the year is the shortest day, the 21st of December, wherein never a gleam has been observed on either year, but Christmas Day shines forth grandly; between 10 and 11 a.m. on Christmas Day not a cloud passed over the sun in either year, and each year the sun has commenced to shine between 8 and 9 a.m., with but very few clouds before noon, generally clouding over about 2 p.m.

The mean annual value is 1,667 hours, an amount of sunshine equalled by but few other places. R. SHEWARD.

Eastbourne.

THE COMMON SPARROW.

Passer domesticus.

The peculiarities relating to the eggs of this bird appear to have been overlooked by ornithologists, namely, the peculiar formation of each clutch of eggs and their great infertility.

The eggs forming a set or clutch are generally four or five, occasionally six are met with, but not more than one set in ten has that number, very probably not more than one set in twenty.

In every set or clutch containing four, five, or six eggs, one egg, occasionally two, will be found of quite a different type. This egg I shall call or name "the odd egg," and the first peculiarity of this odd egg I shall mention is, that with very few exceptions it is of a lighter coloured ground to the others of its set, with the colouring matter laid on in spots and blotches instead of being diffused in specks and speckles more evenly over the whole surface of the shell. An odd egg of a darker colour than the others of the clutch is rarely met with, and in the ninety sets I have now before me there is only one set in which the odd egg has a ground of a slightly darker shade.

The ninety sets of eggs to which I refer were all taken under my own supervision, and all blown by myself, so that I know them to be genuine sets and not made up. In every set containing four or five eggs, the odd egg appears, excepting in one clutch of four and one clutch of five. In these clutches the odd egg may have been dropped when the bird was from home.

I will now mention the extreme infertility of "the odd egg," which I find this breeding season to be about sixty per cent. In the season of 1886 I found it to be seventy-five per cent. This egg is, I believe, as a rule, to be the fourth egg laid, for in clutches of five eggs I have found an egg of the usual type laid after the odd egg has appeared.

In one set of four, with two eggs of the usual type, and two of the odd type, I found the two of the odd type infertile, in the other two incubation was far advanced.

In another set of four, similar to the last mentioned, I found the two eggs of the usual type infertile, and the two bearing the character of the odd egg on the point of hatching. The two sets just mentioned are quite exceptional, and the only two I have at present met with.

In a set of five having one egg dark in colour, another of a rather lighter ground with dark markings, and three of a very light ground and very uniform in size and shape, I thought I had found a set with the odd egg the darkest, but upon examination I found in the two darkest incubation advanced, and the three light coloured eggs without the slightest signs of incubation having set in.

Again, in a set of six, with four rather dark and uniform eggs, and two of a lighter colour, the rule of the lightest coloured eggs being the infertile ones did not stand good, for in this set the two light ones were far advanced in incubation, and the four dark coloured ones showed no signs of it whatever. This being a very exceptional set I have preserved the shells; unfortunately one of the dark shells got broken, so the set shows but five.

During the past two breeding seasons I have had a very great number of clutches of eggs and also broods under my notice, taken over a considerable area in Herts., Cambs., and Essex, and I find the average clutch to be $4\frac{1}{2}$ eggs, and the average brood to be only $3\frac{1}{8}$ young birds; these figures show that about 30 per cent. of the eggs to be unproductive.

From these observations, which I have carefully made, the sparrow is not so prolific as it is generally supposed to be, and it may be quite possible for the "British Farmer" to kill them down too close, and to their present troubles they may add worse enemies than the sparrow to eat their crops.

I believe the foregoing peculiarities have no parallel.

Royston. JOSEPH P. NUNN.

P.S.—There were not more than half the number of sparrows breeding in this neighbourhood last season that there were in the season of 1886, neither were the eggs of last season so well coloured as those of 1886. Five per cent. only of the broods contain five young birds.

ARSENIC IN CRETONNE.

I wish to bring to the notice of your numerous readers a fact that appears to have escaped observation up to the present time. I allude to arsenic poisoning by means of cretonnes, imitation Indian muslins, etc. Dr. Giffard, the medical officer at Coopers'-hill, has brought some cases to me in which he thought he detected symptoms of arsenic poisoning, and in every case the source of the poisoning was traced either to a cretonne or an imitation Indian muslin that had been used as a decoration by the student. As, during the last twelve months, four unmistakable cases of arsenic poisoning have been brought to my notice, I have recently been investigating the subject. The samples upon which the experiments have been performed were supplied by a local tradesman. The results obtained on analysis are as follows: 44 samples of cretonne have been analysed, and of these none were found absolutely free from arsenic, three contain only the very faintest trace, and 21 contain larger traces. The remaining samples all contain arsenic in poisonous quantities; in my analyses I have grouped 11 of them as "very bad," and the other nine are bad and distinctly dangerous. It may be mentioned that one of the worst specimens has been examined quantitatively and yielded an amount of arsenic equivalent to rather more than $19\frac{1}{2}$ grains of white arsenic As_2O_3 per square yard. As a dose of $2\frac{1}{2}$ grains of white arsenic has been known to prove fatal, I should like to point out the extreme danger that exists from the indiscriminate use of these materials. It is quite a common occurrence to have enough of these substances in a room which would contain sufficient arsenic to give one hundred people a fatal dose. As far as the analyses have gone at present they do not show that any one colour is more poisonous than another, as, strange to say, the greens and blues, that would be first suspected, have until now proved purer than reds, browns, and blacks. In the case of imitation Indian muslins, five samples only have been analysed, but they all contained arsenic in poisonous quantities. That such a state of affairs should be allowed in this country at a time like the present seems scandalous, and I would recommend no person to use any of these fabrics for decoration unless either the vendor guaranteed the absence of arsenic or that they had first been analysed by some trustworthy chemist. F. E. MATTHEWS.

Cooper's-hill, Staines.

RELATION BETWEEN THE WAVE-LENGTHS OF LIGHT AND ITS INTENSITY.—Professor Ebert (*Ciel et Terre*) is examining if the speed of light is in any relation to its intensity. He employs interference-gratings, and shows that by this method changes in the wave-lengths amounting merely to the 1-200,000th of their value, or changes in the speed of light amounting merely to $\pm$ 1·5 kilometre per second, may be indicated. Different sources of light were submitted to experiment, and it was proved that the wave-lengths and the speed of light were not changed by one millionth of their value, whilst the intensity of the light varies by 1 to 250.

RECENT INVENTIONS.

The following list has been compiled especially for the SCIENTIFIC NEWS *by Messrs.* W. P. THOMPSON *and* BOULT, *Patent Agents, of* 323, *High Holborn, London, W.C.; Newcastle Chambers, Angel Row, Nottingham; Ducie Buildings, Bank Street, Manchester; and* 6, *Lord Street, Liverpool.*

TELEGRAPHS.—A type-printing telegraph has been patented by Mr. G. A. Scott. This invention consists essentially of a series of magnets, having their armatures so arranged relatively to a flexible connection secured to the type wheel, that the part of the wheel bearing any required character may be turned round to the printing point by opening or closing the circuit of a battery through the coil of one or all of the magnets.

PIPE.—Mr. C. J. Coventry has patented a tobacco smoking pipe. The bowl of the pipe is constructed in the usual manner with a hole at the bottom in line with the stem. Into this hole is placed a solid metal tube, having slots cut in it. When the mouthpiece is screwed on to the bowl of the pipe it pushes the perforated tube into the hole in the front part of the bowl, and renders it air-tight. When it is necessary to let out the nicotine, the stem is partially unscrewed, which thus releases the perforated tube and allows the nicotine to escape.

KNIFE-GUARD.—Mr. A. L. Mora has patented a guard for use with carving forks. The guard or stop proper consists of a piece turning upon centres in the fork shank. The stop is made of a springy nature, so that when it is raised the springing action causes the lower parts of the stop to enter the recesses provided for the purpose, and to be supported thereby. To release the stop it is pressed against the springing action, and so the lower parts leave the recesses, and the stop can be turned out of its raised or effective position.

EXTINGUISHER.—An automatic lamp-extinguisher has been patented by Mr. A. Breden. This invention relates to that class in which two spring-clacks are used, which, when in nominal conditions, are under the upper edge of the wick-tube, but when the lamp is inclined, rise and unite together above the flame, but sometimes fail to put out the light. According to this invention one of these spring-clacks is replaced by rigid plates, which enclose the wick on three sides, the remaining clack being articulated between the lower ends of the lateral walls of these rigid plates, and penetrating between the same under the action of its spring, when the extinguisher is actuated. Thus the tight casing is provided, which effectually extinguishes the lamp.

TYPE-WRITERS.—Mr. H. A. Gruhl has patented a type-writer. The invention relates to that class of type-writers in which the printing mechanism is caused to move above the sheet of paper to be printed upon, and the object is to facilitate the alternate use of two or more sets of type. This is effected in the following manner. Two or more sets of type are made use of, arranged concentrically on the lower side of a segment, the pivot of which can be moved in a rectangular direction, whereon the letters have to appear upon the paper. Controlling rows of letters, which correspond with the types at the under side of the segment, but in the reverse arrangement are attached to the upper side of the segment, and appear alternately according to the position of the type-bearing segment in a segmental slot of a plate fixed above the said pivotted segment.

LAMP.—A velocipede lamp has been patented by Messrs. W. P. Burt and S. B. Edmonds. The object is to prevent the lamp from being affected by the jolting and oscillation of the vehicle to which it is attached. Two metal tubes are fixed to the lamp, in each of which works a metal rod attached to the socket-piece, by which the lamp is held to the vehicle; at the upper portion of each is fixed a washer of leather, through which the rod passes, and at the lower end of each rod is a leathern plunger; at the bottom of each tube is an indiarubber buffer. Between the fixed upper plugs of leather in the tubes and the plungers—upon the rods—are fixed spiral springs, so that, when the oscillation takes place, any movement to the lamp is at once counteracted by the springs. In order to secure a perfectly steady and noiseless action, two wing-pieces lined with leather are attached to the socket, these wing-pieces clipping the outside of the metal tubes which act as a guide.

ELECTRIC MEASURING.—Messrs. W. T. Goolden and G. Evershed have patented a compensating electric measuring instrument. The object is to make the reading of voltmeters independent of temperature, and is attained by winding the coils of such instruments with wires, having different resistance temperature co-efficients. For example, the coil of a voltmeter is wound partly with a wire having a small co-efficient, and partly with a compensating wire having a large co-efficient, the latter wire being coupled in shunt to a portion of the former wire in such a way as to cause the current to flow in opposite directions in the two wires. The resultant magnetic field of the combination coil will then be equal to the difference of the fields due to the two wires, and, by observing certain proportions between the resistances and number of turns of the two wires and the resistance of the shunted portion of the wire having the small co-efficient, this difference may be made constant for constant pressure on the terminals of the coil, throughout a large range of temperature.

RELEASING HORSES.—Mrs. A. D. Durell, London, has patented means for releasing runaway horses from vehicles. To apply the invention to a pair-horse carriage, a rock-shaft is mounted in bearing secured to the splinter-bar of the vehicle. This rock-shaft is provided with short arms projecting horizontally, and to these arms are pivotted bolts, which slide vertically through sockets on the front of the splinter bar. The shaft is actuated by a hand-lever placed near the driver's seat. Plates with holes through them corresponding with the holes in the sockets, and provided with a trace-block, fit into the sockets, and are held in place by the vertical bolts. The pole fits into the chop block in the usual manner, and is kept in place by a metal plate secured to the pole. This plate fits over the sockets on the splinter-bar, in which position it is held by two of the vertical bolts. Should the horses become unmanageable, the driver pulls over the hand-lever, and thereby draws up all the vertical bolts, when the pole and trace-blocks become detached, and the horses are freed from the carriage.

TECHNICAL EDUCATION NOTES.

CENTRAL INSTITUTION OF THE CITY AND GUILDS OF LONDON INSTITUTE.—During the month of July, 1888, the following summer courses of lectures and laboratory instruction for technical teachers and others will be held in the Institute's New buildings in Exhibition Road: 1. Elementary principles of machine-designing—By Professor W. C. Unwin, M.I.C.E., F.R.S. A course of lectures and drawing exercises to be given daily, Saturdays excepted, from 6.30 to 8 p.m., and extending over a fortnight, commencing on Monday, July 2nd. 2. Practical lessons in organic chemistry, intended mainly for teachers of technological subjects—By Professor Armstrong, F.R.S., Ph.D. This course will extend over two weeks, from 10 till 4 daily, commencing on July 2nd. 3. The construction and use of electrical measuring instruments.—By Professor Ayrton, F.R.S. This course will include experimental lectures and special laboratory work. The lectures will comprise the principles and practice of the construction, calibration, and testing for faults of ammeters, voltmeters, ohmmeters, wattmeters, coulombmeters, and ergmeters as used for direct and alternating current systems. The students' practical work will be conducted in a laboratory specially fitted with accumulators, standard instruments, etc., for electrical instrument testing, and they will have the opportunity of examining and practically trying all the more important electrical meters at present in ordinary use. It will extend over two weeks, and will consist of six lectures, from 8 to 9 p.m., on Mondays, Wednesdays, and Fridays in the fortnight commencing on Monday, July 16th; and also of practical work in the physical laboratories, daily from 2 to 5 p.m., Saturdays excepted. 4. Experimental mechanics—By Professor Henrici, Ph.D., LL.D., F.R.S. This course will consist of lectures and practical work in the mechanical laboratory, and will extend over two weeks, from 10 to 4, commencing on Monday, July 16th. 5. The principles of bread making —By William Jago, F.C.S., F.I.C., Examiner to the Institute. This course will consist of lectures and practical demonstrations, and will extend over two weeks, from 10 till 4 daily, Saturdays excepted, commencing on Monday, July 16th 6. Photography—By Captain Abney, R.E., F.R.S., Examiner to the Institute. A course of six lectures, at 8 p.m., on Monday, Wednesday, and Friday in the fortnight, commencing on Monday, July 2nd. 7. Mathematical and surveying instruments—By Arthur Thomas Walmsley, M.I.C.E. A course of six lectures, illustrated by large scale diagrams and instruments lent by various makers, at 8 p.m., on Monday, Wednesday, and Friday in the fortnight commencing on Monday, July 2nd. 8. Gas manufacture—By Lewis T. Wright, engineer to the Nottingham Gas Works. A course of four lectures, at 8 p.m., on Tuesday, July 17th; Thursday, July 19th; Monday, July 23rd; and Tuesday, July 24th. 9. The Application of modern geometry to the cutting of solids for masonry and other technical arts—By Lawrence Harvey, Medallist of the Ecole des Beaux Arts, Paris. A course of six lectures, practically illustrated, at 8 p.m. on Monday, Wednesday and Friday, in the fortnight commencing on Monday July 16th. 10. The craft of the carpenter —By John Slater, B.A., Examiner to the Institute in Brickwork and Masonry—A course of four lectures, at 8 p.m., on Tuesday, July 3rd; Friday, July 6th; Tuesday, July 10th; and Friday, July 13th. Further particulars and a syllabus of each course may be obtained at the Central Institution, Exhibition Road, S.W., or at Gresham College, London, E.C.

ANNOUNCEMENTS.

IRONMONGERS, IRON AND METAL TRADES' EXHIBITION.—An exhibition in connection with these trades is to be held in the Agricultural Hall, Islington, in November next. The exhibits are to include household ironmongery of all kinds, lighting, heating, and sanitary appliances, machinery, implements, and tools.

SALES.

EXCHANGES.

SELECTED BOOKS.

The Laboratory Guide; a Manual of Practical Chemistry for Colleges and Schools. Specially arranged for Agricultural Students. By A. H. Church, M.A., F.R.S., Professor of Chemistry in the Royal Academy of Arts. London: Gurney and Jackson, 1, Paternoster Row. Price 6s. 6d.

Metalliferous Minerals and Mining. By D. C. Davies F.G.S. With 148 Engravings. Fourth edition London: Crosby, Lockwood, and Co. Price 12s. 6d

Rock History: a Concise Note-Book of Geology, having Special Reference to the English and Welsh Formations. By C. L. Barnes, M.A., Science Master at Bromsgrove School. With coloured maps of strata and illustrations of fossils. London: E. Stanford. Price 6s.

The Flora of West Yorkshire, with an Account of the Climatology and Lithology in connexion therewith. By Frederic Arnold Lees, M.R.C.S., L.R.C.P. London: L. Reeve and Co. Price 21s.

Botanical Tables for the Use of Junior Students. By Arabella B. Buckley. Table of Common Terms used in Describing Plants, comprising those usually required in the Cambridge Local Examinations for Juniors. Also a Table of the Chief Natural Orders of British Plants, arranged according to Bentham and Oliver. New and revised edition. London: E. Stanford. Price 1s. 6d.

The Mechanic's Workshop Handy-Book: a Practical Manual on Mechanical Manipulation, embracing information on various handicraft processes, with useful Notes and Miscellaneous Memoranda. By P. N. Hasluck, A.I.M.E., Author of "Lathe Work," etc. London: Crosby, Lockwood and Co. Price 2s.

An Elementary Geography of the British Isles. By Archibald Geikie, F.R.S., Director-General of the Geological Survey of the United Kingdom, and Director of the Museum of Practical Geology, Jermyn Street, London, Author of "The Teaching of Geography," etc. London: Macmillan and Co. Price 1s.

Electro-Plating: a Practical Handbook on the Deposition of Copper, Silver, Nickel, Gold, Aluminium, Brass, Platinum, etc., with Descriptions of the Chemicals, Materials, Batteries, and Dynamo Machines used in the Art. By J. W. Urquhart, C.E. London: Crosby, Lockwood and Co. Price 5s.

An Atlas of Anatomy; or, Pictures of the Human Body. In 24 large Coloured Plates, comprising 100 separate figures, with descriptive letterpress. By Mrs. Fenwick Miller, late Member of the London School Board. Third edition. London: E. Stanford. Price 12s. 6d.

METEOROLOGICAL RETURNS.

For the ten weeks ending on Monday, June 25th, 1888, specially prepared for SCIENTIFIC NEWS from official reports.

	Mean Temperature.	Rainfall.	Duration of Sunshine.
Scotland, East	47·6 degs., being 1·9 degs. below average.	5·1 ins., being 0·2 ins. above average.	448 hrs., being 28 hrs. above average.
England, N.E.	48·7 „ „ 2·5 „ „ „	3·8 „ „ 0·8 „ below „	357 „ „ 47 „ below „
England, East	51·3 „ „ 2·3 „ „ „	3·3 „ „ 1·1 „ below „	390 „ „ 76 „ „ „
Midlands ...	51·0 „ „ 2·2 „ „ „	4·4 „ „ 0·5 „ below „	358 „ „ 50 „ „ „
England, South	51·8 „ „ 2·0 „ „ „	4·3 „ „ 0·1 „ above „	392 „ „ 42 „ „ „
Scotland, West	49·5 „ „ 1·2 „ „ „	8·7 „ „ 2·1 „ „ „	431 „ „ 11 „ above „
England, N.W.	50·3 „ „ 2·4 „ „ „	3·4 „ „ 1·5 „ below „	387 „ „ 48 „ below „
England, S.W.	51·4 „ „ 2·2 „ „ „	5·1 „ „ 0·9 „ „ „	433 „ „ 50 „ below „
Ireland, North	50·0 „ „ 2·1 „ „ „	6·7 „ „ 1·2 „ above „	418 „ „ 21 „ above „
Ireland, South	52·0 „ „ 1·1 „ „ „	8·4 „ „ 2·2 „ above „	418 „ „ 20 „ below „
The Kingdom...	50·4 „ „ 2·0 „ „ „	5·3 „ „ 0·1 „ „ „	403 „ „ 27 „ „ „

Scientific News

FOR GENERAL READERS.

FRIDAY, JULY 13th, 1888.

CONTENTS.

SCIENTIFIC TABLE TALK.

By W. Mattieu Williams, F.R.A.S., F.C.S.

In my last I referred to a discussion with a friend whose views I greatly respect. We were perfectly agreed respecting the truth and universality of the great induction usually described as "the conservation of energy," though I may add, by the way, that I heartily agree with Mr. Herbert Spencer's objection to the form of expression that is generally accepted. He objects to it on the same ground as that of his objection to the term, "preservation of the fittest," for which he has successfully substituted "survival of the fittest." "Conservation of force," or "conservation of energy," as he says, implies "that energy would disappear unless it were taken care of, and this is an implication totally at variance with the doctrine enunciated" (*Nature*, vol. v., page 263). I do not remember whether he has proposed an alternative term.

Indestructibility of energy and indestructibility of force appear to me far better terms. They are more correct and more expressive, besides corresponding with the earlier-accepted description of what is virtually the same, viz., the "indestructibility of matter."

The difference, between myself and friend, referred to the fate of the hailstone supposed to enter our atmosphere with planetary velocity, and having its planetary velocity arrested by atmospheric resistance. According to his view of the doctrine of the conservation of energy the mass of ice—whatever be its size—must be heated throughout, seeing that the motion of the whole mass is arrested throughout. My view is that the whole of the heat into which the mechanical motion is converted is primarily evolved at the place where the arresting force is applied.

It is evident from Sir W. Thomson's slashing criticism of Schwedoft's theory, that my friend's view is shared by others, and I have reason to believe that I am not alone.

To illustrate the difference between these views let us take an imaginary case. Suppose that two bodies of equal mass, both solid, perfectly rigid, inelastic, and incompressible, and both non-conductors of heat, are moving with equal velocities in exactly opposite directions, and then come in collision. The visible motion of both will be arrested, and then what will happen? According to the first view each body will be instantly heated throughout. According to my view, they will be heated only at the colliding surfaces.

We cannot actually make this experiment, because we can find no substances having the perfect rigidity, etc., demanded, therefore the reader may fairly ask why I make such demands in my ideal case. This will appear as I proceed.

According to my view, the arrest of motion is only apparent. I regard the conservation or indestructibility of motion as the fundamental fact, and the conservation or indestructibility of what we call energy as merely the outcome or sensible expression of this. In all practical cases of collision the mass-motion is converted into several motions, a part of it directly into heat motion, another part into mechanical vibration, another possibly into electrical or chemical motion, etc., as the case may be.

As an example of such communication of motion in other form than that of heat, I may mention that when in Sheffield I was consulted concerning damage alleged to be done by certain steam-hammers in shaking the foundations of surrounding houses, and devised a simple instrument—a sort of seismometer—which proved that a hill about 200 feet high, half a mile long, the summit of which was about one-third of a mile distant from the hammers, was bodily shaken by the concluding strokes of the hammer upon blooms of puddled iron. When the steam-hammers were very busy the crockery ware placed on shelves in the houses around was endangered, as the general vibration caused it to travel gradually to the edge of the shelves and then topple over.

In this case a considerable proportion of the arrested mechanical motion of the hammer was merely transferred as mechanical motion to the body of the earth, and thence to the houses, etc.

A further examination of the doings of such steam-hammers is instructive. When the glowing, spongy ball of iron receives its first few blows, it crushes down, and at each compression its temperature is visibly increased.

In the case of the tilt-hammer, when applied for welding a "faggot" of steel strips together, the success of the proceeding is dependent on the fact that the blows are dealt in such rapid succession that the steel is maintained at a welding heat, which it would lose if exposed for the same length of time without the hammering.

In these cases the hammer-head itself, although it is the moving body whose motion is arrested, is but slightly heated. The inner portion of its mass, its centre of momentum, is practically unaffected, the only actual effect on this being due to vibration communicated by its elasticity and imperfect rigidity. The main heating occurs within the mass of the yielding metal, where the mechanical motion is arrested by internal friction. When it becomes more rigid, and ceases to supply this internal resistance, we have the well-known banging thuds that shake the foundations of the solid earth.

Die-sinking and coining afford another example. The die is of hardened steel, and its descent is suddenly arrested. Heat is thereby generated, but where? Certainly not in the mass of the die. If so, the vigorous proceedings at the Royal Mint would soon soften the hard steel of which the dies are made. The coins are heated considerably, and the metal of which they are composed flows into the device on the face of the die. The weight of metal thus heated in the course of a day's work is many hundred times greater than that of the die itself.

When the blacksmiths of olden times lighted their forge fires by converting the mechanical motion of their hammers into heat-motion, it was not the hammer-head that they applied to the brimstone match, but the piece of soft iron that arrested the motion of the hammer. An instructive experiment may be made by taking a leaden bullet and a corresponding piece of iron, hammering each on an anvil, and comparing the temperature of the victims. Both will be warmed, but the lead will be found to become much hotter than the iron, and the hammer itself not sensibly warmed.

I contend that these facts, and a multitude of others that might be specified, teach us that it is not the negative arrest of visible motion of the moving body, but the positive conversion of this kind of motion into another kind of motion, that effects the rise of temperature, and that in all cases such conversion must and does occur where the effective resistance occurs, whether that be on the surface or within the substance or outside the mass of the colliding bodies. (For further illustration of this, see chapter 5 of my "Simple Treatise on Heat," published by Chatto and Windus.)

In the imaginary bodies of perfect rigidity it would be all superficial, producing superficial fusion, volatilisation, or dissociation according to quantity. In a perfectly compressible and perfectly elastic body it would be all internal, as is proved when we drive a close-fitting piston into a closed cylinder of air or other gas, or, what amounts to the same, if the piston be at rest and we drive the gas in the cylinder towards it. Here the resistance occurs internally, and the heat is therefore internal.

If we apply a friction break to arrest the motion of a solid fly-wheel, the heat appears on the surface where the break is applied. If the fly-wheel be fluid, as a vortex of gas or liquid, and the break be applied by a resisting paddle within the fluid, the heat will appear within the fluid, commencing at the place of impact with the paddle, the heat being simply the other motion which is there set up in exchange for the mechanical motion.

THE "VOLTAIC BALANCE."

A NEW and simple lecture experiment has recently been devised by Dr. G. Gore, F.R.S. It is conducted in the following manner: Take two small clean glass cups containing distilled water; simultaneously immerse in each a small voltaic couple, composed of either unamalgamated magnesium or zinc, and platinum, taking care that the two pieces of each metal are cut from the same piece and are perfectly clean and alike. Oppose the currents of the two couples to each other through a sufficiently sensitive galvanometer, so that they balance each other and the needle does not move. Now dip the end of a slender glass rod in a very weak aqueous solution of chlorine, bromine, iodine, or hydrochloric acid, and then into the water of one of the cups. The voltaic balance is at once upset, as indicated by the movement of the needle, and may be shown to a large audience by means of the usual contrivances.

The chief circumstance to be noticed is the extremely great degree of sensitiveness of the arrangement in certain cases; this is shown by the following instances of the minimum proportions of substance required to upset the balance, with an ordinary astatic galvanometer of 100 ohms resistance, and with a Thomson's reflecting one of 3,040 ohms resistance.

1. *Zinc and Platinum with Iodine.*—With the astatic galvanometer between one part of iodine in 3,100,000 and 3,520,970 parts of water.

2. *Zinc and Platinum with Hydrochloric Acid.*—With the astatic galvanometer between 1 in 9,300,000 and 9,388,185 parts; and with the reflecting one, between 1 in 15,500,000 and 23,250,000 parts.

3. *Magnesium and Platinum with Bromine.*—With the astatic galvanometer between 1 in 310,000,000 and 344,444,444 parts.

4. *Zinc and Platinum with Chlorine.*—With the astatic galvanometer between 1 in 1,264,000,000 and 1,300,000,000 parts.

5. *Magnesium and Platinum with Chlorine.*—With the astatic galvanometer between 1 in 17,000,000,000 and 17,612,000,000 parts; and with the reflecting one, between 1 in 27,062,000,000 and 32,291,000,000 parts of water.

Every different soluble substance requires a different proportion, and with unlike substances the difference of proportion is extremely great. With solutions of neutral salts, the proportion of substance required to upset the balance is large; for instance, with chlorate of potash, a zinc platinum couple, and the astatic galvanometer, it lay between 1 part in 221 and 258 parts of water.

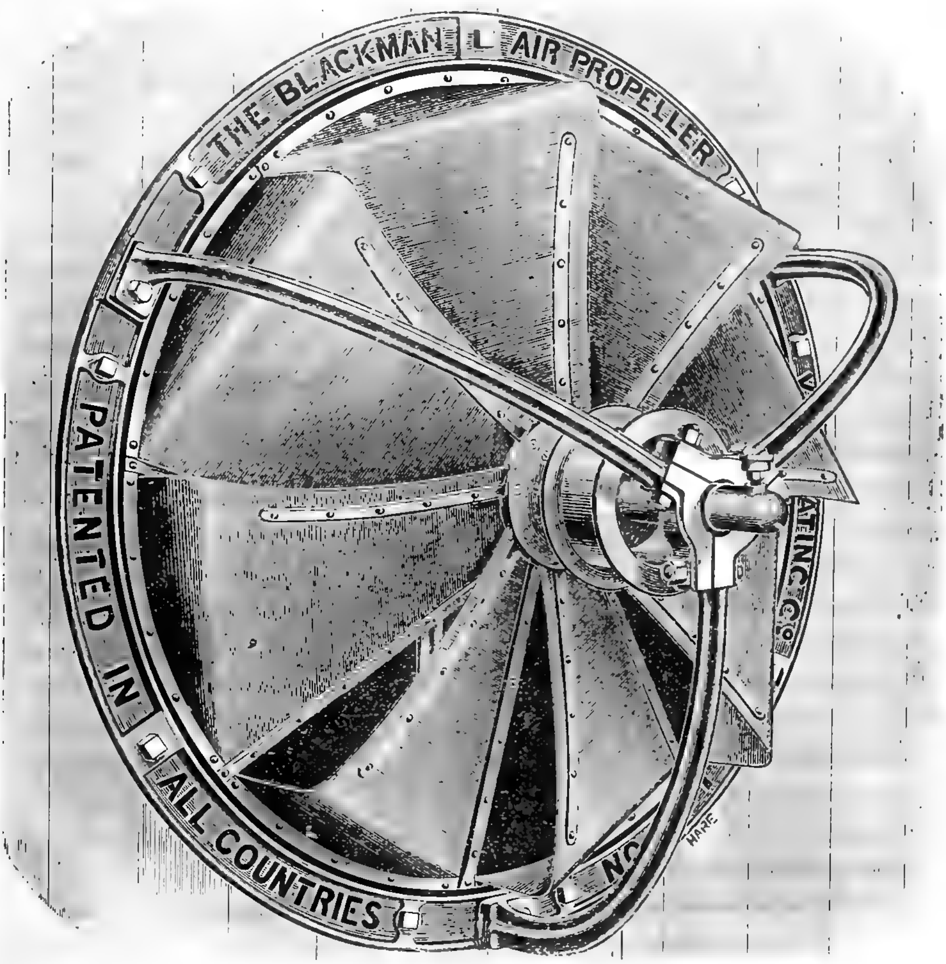
The degree of sensitiveness of the balance is usually greater, the greater the degree of chemical affinity the dissolved substance has for the positive metal, and the less it has for the negative one.

By first bringing the balance with a magnesium platinum couple and the astatic galvanometer nearly to the upsetting point, by adding 1 part of chlorine to 17,612 million parts of water, and then increasing the proportion to 1 in 17,000 millions, the influence of the difference, or of 1 part in 500 millions, can be distinctly detected.

THE SENSES OF INSECTS.—Franz Ruland (*Zeitschrift fur Wissenschaftliche Zoologie*) considers that insects possess in their antennæ a series of different olfactory organs, specifically perceptive of different odours.

THE BLACKMAN AIR PROPELLER.

THE importance of ventilation as one of the hygienic conditions necessary for health should be a truism. We regret to say it is far from being so, especially in crowded workshops and places of public resort, such as theatres, concert halls, churches, etc., and even when the need for ventilation is recognised, how inadequate are the means often adopted for effecting it. In the majority of cases it is admittedly difficult to ventilate efficiently, *i.e.*, to produce a constant supply of fresh air without inconvenient draughts, and without occasional reversals of current or downdraughts, caused by wind, or by the temperature of the external air being higher than that of the air inside the building to be ventilated.



Without doubt, the most sure and efficient way of ventilating large buildings is to forcibly exhaust the hot and vitiated air by mechanical means. This is usually effected by rotary fans driven by water or engine power. Much, however, depends on the shape of the fan, and although the Blackman is doubtless known to many, it has some distinctive features which some of our readers may be glad to have brought to their notice. In the first place it exhausts or delivers a large volume of air without materially raising its pressure, whereas the other fans in use generally drive in air at a considerable pressure. The latter system is the best when a strong current of air is required as for instance in the ventilation of the complicated working of coal-mines, where the resistance to be overcome is considerable. Blast fans are also very useful for producing the currents of great intensity required for smiths' forges, foundry cupolas, etc. The Blackman propeller is specially designed to move large volumes of air at low speed, and is therefore well suited for the ordinary purposes of ventilation. The eight blades of this air propeller, as will be seen in the accompanying figure, are curved in a special manner, not only to catch the surrounding air, but to draw it towards the centre, and then finally to push it forcibly through the propeller itself. Their peculiar construction also prevents the escape of air radially, which is a common defect in most other rotary fans

The following table, supplied by the makers, gives the work done, and the power required to do it, for the different sizes of the propeller, when there is a free inlet as well as a free outlet for the air.

Diameter in inches.	Revolutions per minute.	Cubic feet of Air moved per minute.	Actual horse power required
14	1,000 to 1,500	1,500 to 2,500	Fractional.
18	700 „ 1,200	2,000 „ 4,000	Ditto
24	500 „ 900	3,000 „ 6,000	¼ to 1
36	400 „ 650	7,700 „ 14,000	½ „ 1½
48	300 „ 600	13,500 „ 30,000	1 „ 2½
60	240 „ 450	21,000 „ 43,000	1½ „ 3½
72	200 „ 350	30,000 „ 58,000	2 „ 5

When driven within the limits of speed best suited for ventilating buildings, the air is moved at the rate of about 15,000 cubic feet per minute per horse power, and this is certainly an excellent performance. The higher the speed the greater is the power required for a given volume, and a large size run slowly is better than a smaller size driven quickly, unless considerable resistance has to be overcome.

Besides ventilation, the Blackman propeller is largely used in many industries for drying purposes, such, for instance, as the drying of cloth, timber, paper, wool, glue, etc. In many cases the heated air drawn from one part of a building may be used for drying or warming in another, or the air to be used for drying may be made to pass over heated pipes. One firm of furniture makers have four drying chambers, in which about twenty tons of timber are dried weekly by means of heated air drawn through them by two Blackman propellers. The temperature of the chambers is maintained at about 80° Fahr., and the timber is said to be in good condition for working when taken out, and free from cracks or warps. Rooms through which heated air is drawn by propellers, are also used for the drying of leather and card, or mill-boards, these materials being hung as nearly edgewise to the air-current as is practicable.

The dust and fumes produced in many factories are highly injurious to health, and it is most important that they should be removed from the workrooms. In white-lead works the fumes are poisonous, and in the grinding of steel and iron in the cutlery and other trades, the fine metallic particles are a fruitful source of lung disease. Again, the dust from wool often gives rise to the dreaded wool-sorter's disease, which generally ends fatally. It is caused by a minute organism called the *bacillus anthracis*, which is conveyed by the skin or wool of animals which have died of splenic fever. All these dangers may be minimised by a proper system of ventilation, but, although this is well understood, it is surprising to find it neglected, even in some of our best appointed factories.

It has been suggested that much of the fruit which is lost in this country, where there is not sun enough to dry it, may be preserved by air-drying. In warmer climates raisins, currants, apples, plums, etc., are dried by the sun after being gathered, and are then sent to England for sale. In our less favoured and uncertain climate this cannot be done, and fruit growers will do well to try thoroughly the above suggestion of drying their fruit in chambers by means of an air-propeller.

THE AUDITORY ORGAN OF THE GNAT.

LOVERS of minute anatomy will find this a curious subject for microscopic study. Capture a male gnat, known by the beautiful plumose antennæ, moisten with alcohol, and afterwards dissect out with fine needles in a drop of water. One of the antennæ is to be cut off, and the large basal joint is the special subject of investigation. This is seen to be of almost spherical shape, but flattened on its free surface, to which the second joint is attached. When the second joint is removed a sunk circular space is seen upon the large first joint. To the bottom of this cavity the second joint was attached, and the radiating muscles, by which it was moved this way or that, can be made out in a successful preparation. A fortunate cut will now and then reveal the true character of the basal joint, which we shall describe by comparison with a more familiar object, viz., a common paraffin lamp. In this the flame is screened by a chimney and a globe. Suppose that the upper edge of the globe is turned downwards, so as to form an inner and much smaller globe, to the bottom of which the chimney is fixed: the double globe thus formed represents the large basal joint, while the chimney corresponds to the rest of the antenna. We must next suppose that the space between the inner and outer globes is filled with fluid. A cylindrical wick passing up the chimney would indicate the position of the antennary nerve, but to complete the resemblance we must further suppose that a circular fringe of filaments, beautifully regular in disposition, passes off from the outer surface of the wick, and penetrates the closed fluid-containing chamber. The essentials of an auditory organ have now been brought together. We have the closed cavity filled with fluid, the numerous nerve-filaments, and the modified hairs (?) in which these end. It is easy to imagine that the nerve-endings may be of various lengths, each responding to a particular kind of sound-wave, but we have no direct proof that this is actually the case. The organ just described will furnish an interesting and not too difficult subject to the microscopist who has a little skill in manipulation. The external features of the antenna of the male gnat were figured more than 200 years ago by Swammerdam in his "Biblia Naturæ." Its internal structure was well described by Dr. Christopher Johnston, of Baltimore, in vol. iii. of the "Quarterly Journal of Microscopical Science" (1855).

DYE COLOURS FROM PLANTS AND SHRUBS.

A VARIETY of very useful colours and dyes may be obtained from very common plants, growing in abundance almost everywhere. The well-known huckleberry, or blueberry, when boiled down with an addition of a little alum and a solution of copperas, will develop an excellent blue colour; treated in the same manner with solution of nut galls, they produce a clear dark-brown tint, while with alum, verdigris, and sal-ammonic, various shades of purple and red can be obtained. The fruit of the elder, so frequently used for colouring spirits, will also produce a blue colour when treated with alum. The privet, boiled in a solution of salt, furnishes a serviceable red. The shoots of the common burning bush, "euonymus," when treated with sal ammoniac, produce a beautiful purple red. The bark of the currant bush treated with a solution of alum produces a brown. Yellow is obtained from the bark of the apple tree, the box, the ash, the buckthorn, poplar, elm, etc., when boiled in water and treated with alum. A lively green is furnished by the brown corn.—*Scientific American.*

THE USES OF SACCHARINE.—According to the *Medical Press and Circular*, the Seine Council of Hygiene has received a report presented by Dr. Dujardin-Beaumetz, which declares saccharine to be not an aliment but a medicament. They are moreover convinced its main use in industry will be in adulterating alimentary products. The report was unanimously adopted by the Council, and the probable result will be the prohibition of saccharine in all articles of food.

EXTRAORDINARY ESCAPE FROM LIGHTNING.

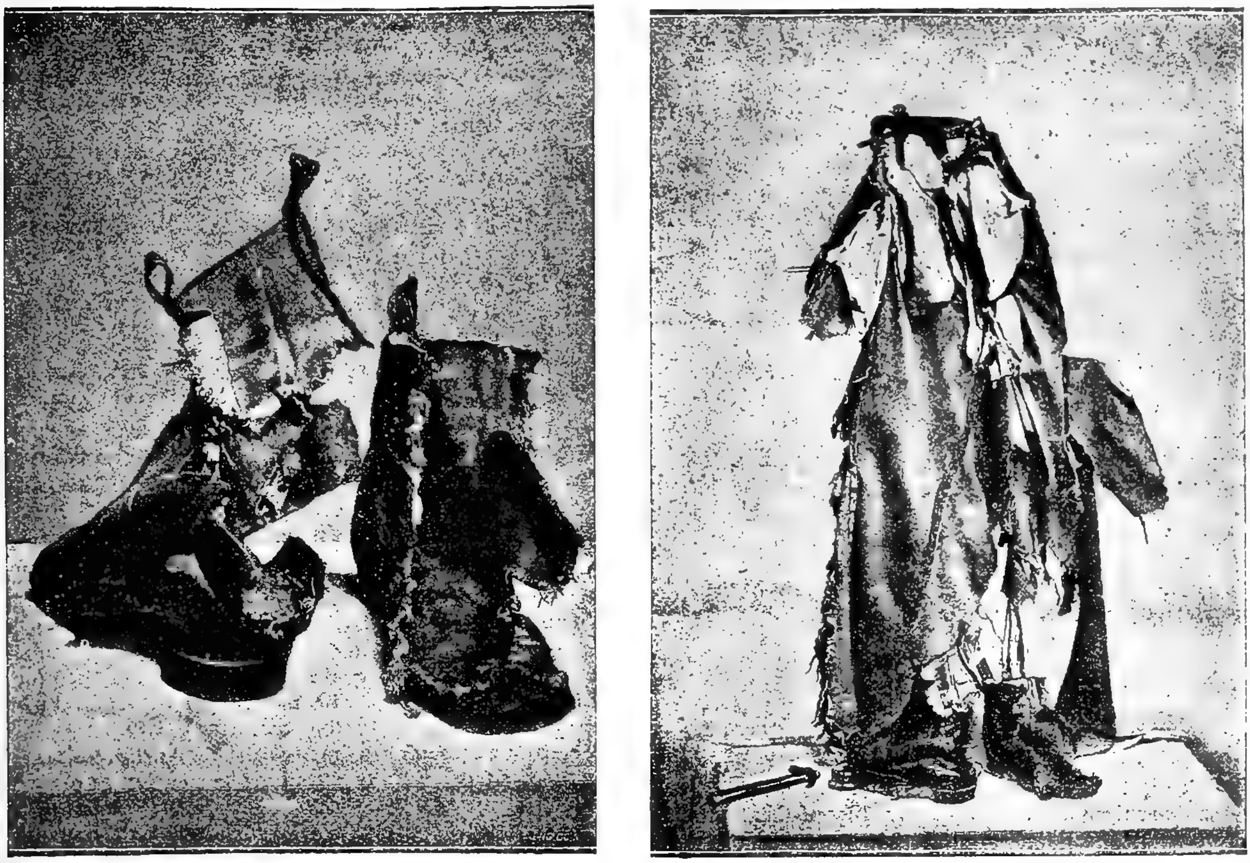
IN a letter to the *Scientific American*, Mr. J. B. de Motte, of De Pauw University, Greencastle, Ind., describes an extraordinary escape from lightning. He writes:

The narrowest escape from death by lightning of which I have ever heard came to my knowledge while lecturing a few weeks ago at the Florida Chautanqua. The drug store, which is used as a post-office by the good people of De Funiak, stands between the railroad station and their beautiful little lake. At the time to which I refer it was "protected" by a common-sized-twisted copper-band lightning rod, with iron core, fastened to the house by glass insulators in the old-fashioned way. Several houses in the town were "rodded" in the same way, but after this one was so badly shattered they were torn off by their owners, "to lessen their chances of getting struck, you know," they explained. About a hundred feet back of the post-office stood two fine specimens of the tall pines which grow so abundantly in that region.

On the afternoon of the 18th of last August, at about one o'clock, a number of boys and men had collected under the post-office porch, thinking, on account of the lightning rod, that they would be safe from the lightning, which was playing rather freely from an only partially cloud-covered sky. Among them was John Chisholm, a merchant of De Funiak, who was sitting about halfway between the corner post of the porch and the nearest window.

The lightning struck the two high pines, and after shattering their tops, leaped to the rod, completely melting its points, and then ran along the comb of the roof to the gable and down a corner. Mr. Chisholm's only recollection of the stroke is a sensation like that of a heavy blast of hot air striking him between the shoulders. He was thrown forward upon his face, and taken up for dead. His shoes were new and his trousers nearly so, yet they were left looking very much as if they had been attacked by an army of hungry rats. The engravings, which are made from photographs which I had taken for the purpose, give a fairly good idea of their condition. How a man could have his clothes chewed off from him by lightning in that style and still live, is a mystery. His shirt was torn entirely in two. His body was badly blistered, especially from the knees down. Becoming conscious, he experienced a terrible feeling of suffocation and "heartache, as though it would burst." He remained helpless for four months, suffering terribly from aching in the bones and a stinging sensation, "as though a thousand needles were being stuck all over my body."

Now, after a lapse of over nine months, Mr. Chisholm has gradually recovered the use of his limbs, only suffering from an occasional violent involuntary jerk in the back. He attends to business, and has recovered much of his former sociability.



MR. CHISHOLM'S NEW GAITERS AND CLOTHING AFTER THE STROKE.

THE NATURALIST AT THE SEA-SIDE.

1.—The Tow Net.

On a fine sunny day the naturalist at the sea-side can get many treasures by working a tow-net. This is a long tapering bag, from three to five feet long, made of stout and fine muslin. The open end is sewn to an iron hoop from six inches to a foot in diameter. The other end is open, but fitted with tape so that it may either be tied up or have a glass tube inserted. The hoop is held by means of three cords knotted into one. For special purposes one side of the hoop may be weighted, and the opposite side buoyed up with cork, but the tow-net should never be made so light as to float. When the net has been plied on the surface of the sea for half an hour, it is turned inside out into a clear vessel of sea-water. The captured animals float out and are either examined on the spot, or preserved for future study. Glass dipping-tubes of different sizes are needed to pick up small objects, and "concentrators" are useful for getting rid of the great mass of superfluous water. The concentrator is a lacquered cylindrical tube, made of fine gauze above, but capable of holding a small quantity of water below. If a gallon of water be poured through it all the visible organisms which it contains will be strained out into an ounce or two of fluid in the bottom of the tube. In working the net, a rowing-boat, or anything that moves on the sea, can be used, provided that it does not go too fast. A speed of two or three miles an hour is suitable.

So much for the tackle and mode of working. We will now suppose that our naturalist is at sea. Since it is just as easy to wish him good luck as bad, we will further suppose that he has a bright day and still water. If he is in a small boat he should have two or three wide jars at his feet, each to serve for a separate haul. If he be in a large craft and out for the day he must further be provided with a portable microscope, collecting tubes, and a supply of preservative fluid.

The things that he will find depend upon season and locality. To name all the likely things would be to empty a zoological text-book upon our readers. Let us be moderate then and notice only three kinds of animals, which are commonly met with and well worth study. The tow-net is pretty sure to bring up (1) small swimming crustacea, microscopic shrimps we might call them; (2) medusoids, and (3) echinoderm larvæ.

The surface crustacea will afford endless occupation in the determination of species, but this is work for the specialist. It will be enough for the beginner if he can recognise two orders which are sure to be met with, leaving details to others. The orders in question are the amphipods and the copepods. The amphipods are generally flattened from side to side, and provided with a crowd of legs beneath. At the tail-end are three pairs of tail-fins, which are used to make a sudden leap in the water. The legs next in front are very small. The copepods may be recognised with a pocket-lens as small, many-jointed crustacea, having four or five branched swimming legs on the fore part of the abdomen, and behind these a five-jointed tapering tail, without appendages. Far more interesting than these to the young biologist are the many larval crustacea which swim on the top of the summer sea. Look up, for instance, in any good manual of zoology, the larval form known as a *Nauplius.* The nauplius is an ancestral crustacean type, which was no doubt in its day an adult stage. In these later ages of the world's history it is usually a transitory phase of crustacean life, generally turning into something else, and ending up as a barnacle, a copepod, or a shapeless parasite. The zoæa, or larval stage of many crabs, is another and more advanced embryo, whose form should be studied beforehand. There is a world of interesting speculation opened out by these crustacean larvæ. Anyone who has examined under a microscope a nauplius and a zoæa in a watch-glass of sea-water will know what to make of those discussions of Darwin, and Haeckel, and Fritz Müller which seem so hard and dry to those who seek to master zoology by mere reading and thinking.

The tow-net often brings up medusoids, which at first sight look like brown or red spots entangled in a clear jelly. Give them plenty of water to swim in, and watch them under the microscope until you can make out the eye-spots and the tentacles, and the polyp hanging down in the middle of the transparent bell. These medusoids are detached from tree-like colonies, and will in turn produce such colonies again.

If your curiosity is capable of being roused by strange transformations you will find echinoderm larvæ very fascinating. The Bipinnaria of the star-fish, and the Pluteus of the echinus or sand-star are common forms. Utterly unlike the adult animals, into which they are transformed, these larvæ are well adapted for locomotion. They have long arms, ciliated bands, and a delicate skeleton of calcareous spicules. Elaborate figures would be needed to give even a rough notion of their various shapes. Sometimes the rudiment of the permanent body may be seen budding out from the larva.

The zoologist who has become familiar with the crustacean, hydrozoan, and echinoderm larvæ may exercise his thoughts profitably upon the great number of marine animals which develop with conspicuous metamorphosis. It is quite otherwise with animals of high grade, and with all the inhabitants of land and fresh waters. These, as a rule, develop directly. In the waters of the sea locomotion is very easy and advantageous, and at the same time enemies abound. These conditions favour the production of a vast brood of tiny embryos, which disperse at once in search of food, and only attain the adult condition by an entire change of structure and mode of life. In fresh waters, on the other hand, locomotion is limited by the small size of the area, while life is a less difficult struggle than in the sea. Fewer embryos are produced, and these are cared for by their parents, if only to the extent of having a good supply of food-yolk laid up for them in the egg. They hatch out in a comparatively advanced condition, resembling the parent, except in size. Terrestrial conditions are unfavourable to metamorphosis, owing to the difficulty which the immature animal finds in moving about on dry land. Lastly, all big and strong animals of high intelligence find it best to bring up a few young at a time, and to feed and protect these few until their development is far advanced.

We must add a few words about preservatives. Picric and chromic acid solutions are of great use in special cases, and have the merit of being extremely cheap. The picric acid solution should be saturated, the chromic acid one quarter per cent. For general purposes nothing is better than Haentsche's fluid, viz., a mixture of glycerine (two parts), methylated alcohol (one part), and distilled water (one part). After placing in the fluid, sort out the organisms by means of a dipping tube into little bottles, and be careful to label each with time and place of capture.

General Notes.

Stellar Studies.—We learn that Mr. J. Ellard Gore, F.R.A.S., etc., has in the press a volume entitled "Planetary and Stellar Studies: papers on the Planets, Stars and Nebulæ." It will shortly be published by Messrs. Roper and Drowley.

Manufacture of Aluminium.—A new company for the production of this metal is being formed in London. It holds a number of valuable patents and improved processes, and hopes to produce aluminium, not in small globules, but in ingots weighing above one cwt., and at the price of 1s. per lb. If these expectations are realised the metal will meet with an immense demand.

Scientific Training.—We are glad to learn that in one at least of the four Inns of Court there are being delivered lectures on mechanics, electrical engineering, toxicology, and psycho-pathology. Much time, trouble, and perhaps failure of justice will be avoided in patent-cases, complaints of nuisances, and charges of poisoning if counsel can thus be rendered competent to appreciate the evidence of experts.

The Origin of the Diamond.—Professor Simmler, supposing that the liquids occasionally found enclosed in diamonds are liquefied carbonic acid, suggests that the diamond may be formed by the crystallisation of a solution of carbon in such liquid carbonic acid. It is certainly known that diamonds have exploded without ostensible cause, a fact so far in harmony with Professor Simmler's supposition, but it has not yet been proved that carbon is soluble in liquid carbonic acid. The experiment is worth trying.

Curious Phase of Combustion.—M. Hirn sent lately to the Academy of Sciences an account of a very remarkable phenomenon which came under his observation. Having extinguished a spirit lamp, he saw a luminous point remaining for more than eight hours on the charred part of the wick, and finally traced it to a little block of carbon, the sides of which did not exceed a millimetre in size. This little block played the part of a platinum coil heated to whiteness, and remaining incandescent in the vapours of alcohol.

Petroleum in the Punjab.—According to *Indian Engineering*, quoted in *Invention*, Mr. Noble, of Canada, a great "oil" man, has obtained a concession from the Government of India to prospect for three years in the Punjab for mineral oil, and at the end of that time the right to take up 50,000 acres in case of success, with the privilege of supplying the whole of the North-Western Railway system with lubricating oil. His men and machinery are going out in September to begin operations. Mr. Noble is a brother of Colonel Noble, R.A., Superintendent of the Government Powder Works, Waltham Abbey.

The Permanence of Climate.—It has been lately asserted on theoretical grounds that the northern hemisphere reached its maximum temperature in the thirteenth century, and that the climate has since been growing progressively colder. A fact recorded in *Cosmos* does not agree with this supposition. On demolishing an old house at Thil, on the banks of the Rhône, there has been found a tablet of wood bearing the inscription in an old patois, "Le Rone a iele, 1670," which can only mean "the Rhone has frozen." Now as this exceedingly rapid river has never been frozen in the subsequent 218 years, we can scarcely admit that the climate of France has been deteriorating.

The Properties of Aluminium.—MM. Friedel and Crafts have determined the melting-point, the boiling-point, and the vapour-density of aluminium, and have laid the results before the Academy of Sciences. The vapour-density had been previously determined by MM. Sainte-Claire Deville and Troost at the boiling temperatures of mercury and of sulphur, and found to agree with the formula Al_2Cl_6. Recently MM. Nilson and Petterson have made a series of observations at a higher temperature, and deduced the formula $AlCl_3$. It results from the experiments of Friedel and Crafts, made between 218° and 440° C., that the density is constant for more than 200°, and answers to the formula generally admitted.

Research.—We have received the first number of a new monthly journal, published in Liverpool, called *Research*. In the introductory programme it is stated that a careful digest will be given of what has been and is being accomplished by workers of the first order. Also that the special value and bearing of this knowledge will be pointed out, as well as how such work may be supplemented, and how new lines of inquiry may be started. Such a programme is comprehensive, if not a little too ambitious, but we shall cordially welcome the fulfilment of what is promised. It is true that in the first number there is a total absence of the digest and of the teaching above referred to, but we cannot but suppose that this inconsistency will disappear in the next number. We notice also that most of the information given, under various headings, is essentially of a local character.

Anti-Science.—In a book bearing the strange title of "The Anointed Seraph; the Last Made First," written by G. H. Pollock (Sherry, Washington), may be read the following passage:—"The earth which we inhabit, and of which we are a part, was made up through involution of all the various products and qualities of the disturbed solar lights. Water came from Taurus, oxygen from the Great Bear, amativeness from Capricornus, copper from the Whale, steel from the Little Bear, gems from Scorpio, black hair from Aquarius, gold from the Crown, salt from Orion, mercury from Mercury, sulphur from Jupiter, alkaline substance from Venus, diamonds from Andromeda, verdigris from the sun spots, iron from Hercules, silver from the Pleiades, soapstone from the Hydra, loadstone from the Pole Star. The life of the world was the nature and personality of the digressor from the seventh sun, who through the progress of involution became inverted, passing from the divine to the material state." Leaving our readers to ponder over this jumble, we can only express our sorrow that men can be found to write, to publish, and, we fear, to read such productions.

THE MOVEMENT OF THE EARTH AND THE LENGTH OF THE DAY.—Mathematicians have exercised their ingenuity in calculating the gradual lengthening of the day in consequence of a progressive retardation of the Earth's rotation on her axis. Professor Young, in a lecture recently delivered in Princeton, and noticed in *Astronomie*, argues against the data on which their calculations are founded. He shows that the retarding influence of the tides is compensated by the fact that the Earth gradually contracts, owing to progressive refrigeration, which tends to accelerate its rotation. Geological causes seem also to neutralise each other reciprocally. An accumulation of matter in the equatorial regions, would have the effect of retarding the motion of the Earth, and such an accumulation is being effected by the Mississippi, which conveys its deposit into the Gulf of Mexico. The rivers of India also work in the same direction. But the rivers of Siberia, the Mackenzie, and other rivers produce an opposite effect by conveying their *débris* towards the pole. The Nile, La Plata, and Orinoco also convey matter away from the equatorial regions, whilst not a few of the longest rivers, such as those of China, the Amazon, and the Congo, flow in a west-easterly direction. Hence we may here fairly assume a compensation. The accumulation of ice at the poles must also compensate the loss of velocity due to the tides.

FURTHER OBSERVATIONS ON MARS.—The condition of this planet has been made the subject of further observations by M. Fizeau in a communication to the Academy of Sciences. It is an error to compare the condition of Mars with that of our Earth. Mars is more remote from the sun than are we in the proportion of three to two. The heat and light which it receives from the sun are about four-ninths of our allowance. Hence there is a mean climate comparable to that of our polar circles. Further the atmosphere of Mars is not like ours, which, as every one knows, absorbs and stores up the solar heat on the surface of the ground. Mars has no equatorial bands indicating the presence of clouds, that is, of watery vapour suspended in the atmosphere. It follows that about two-thirds of the proportion of gases forming our atmosphere, and serving as a storehouse for the heat, are wanting on the surface of Mars, which is consequently undergoing a state of glaciation. Besides, the seasons of Mars are about twice the length of ours; the long summers melt the foot of the glaciers a little, but the prolonged and severe winters which follow restore to these colossal masses what they have lost. In short, Mars is an immense glacier. M. Janssen agreed with the views of M. Fizeau on the constitution of the atmosphere of Mars, which he considers to be a planet geologically older than our Earth.

THE PUBLIC HEALTH.—The Registrar-General's return for the week ending June 30th shows that the deaths registered during that period in twenty-eight great towns of England and Wales corresponded to an annual rate of 15·9 per 1,000 of their aggregate population, which is estimated at 9,398,273 persons in the middle of this year. The six healthiest places were Brighton, Huddersfield, Sunderland, Bristol, Birmingham, and Blackburn. In London 2,289 births and 1,238 deaths were registered. Allowance made for increase of population, the births were 446 and the deaths 261 below the average numbers in the corresponding weeks of the last ten years. The annual death-rate per 1,000 from all causes, which had been 14·2, 14·2, and 14·5 in the preceding three weeks, rose last week to 15·1. In the thirteen weeks of last quarter the death-rate averaged 16·9 per 1,000, which was 3·0 below the mean rate in the corresponding periods of the ten years 1878-87. The 1,238 deaths included 20 from measles, 19 from scarlet fever, 28 from diptheria, 27 from whooping-cough, 10 from enteric fever, 36 from diarrhœa and dysentery, 2 from cholera and choleraic diarrhœa, and not one from small-pox, typhus, or any ill-defined form of continued fever; thus 142 deaths were referred to these diseases, being 124 below the corrected average weekly number. In Greater London 3,032 births and 1,530 deaths were registered, corresponding to annual rates of 28 6 and 14·4 per thousand of the population. In the outer ring 4 deaths from scarlet fever, 4 from whooping-cough, and 3 from diphtheria were registered. Two deaths from scarlet fever occurred in Willesden sub-district and 2 from wooping-cough in Wimbledon sub-district.

A GERMAN ANTARCTIC EXPEDITION.—The exploration of the Antarctic regions is to be taken out of our hands and those of Australia. It will be remembered that some time ago a half-hearted proposal came from Australia that the Home Government should contribute £5,000 towards an Antarctic expedition, to which Australia would contribute a like sum. A discouraging reply was returned. It was represented, and rightly, that £10,000 would go a very little way towards the exploration of this enormous area of unknown surface; but that it was the intention of Her Majesty's Government "at a future time" to take up the undertaking, and then Australia would be invited to co-operate. But the few persons in Australia really interested in Antarctic exploration were not satisfied with this, and since then have been casting about to find some means of carrying on the work independently of the mother country. But so far their success has not been great. By the time Her Majesty's Government is ready to consider the subject the work will have been done by Germany, and as in recent colonial enterprises our enthusiasm will be kindled when it is too late. It is intended to place in the Prussian estimates a very considerable sum for an Antarctic expedition. A large staff of the best men obtainable will be engaged, naval and scientific, and the organisation of the expedition has been placed in the hands of Dr. Neumayer, of the Hamburg Observatory, who is, perhaps, the greatest authority living on Antartic matters. It is intended, we understand, that the expedition will stay out until our knowledge of this almost unknown region has been substantially extended. At present it is believed that within the Antarctic Circle there must be a very large area of land. We know that there is a long range of high mountains, and at least one great volcanic peak. It will be stipulated that the members of the expedition shall exert themselves to their utmost to explore the region, so that within a very few years we may expect to have another great blank in the globe filled up, and that not by the country of Ross whose Australian colonies have a practical interest in the physiography of the Antarctic, but by a nation whose interest in the subject is of a purely scientific character. The expedition, we believe, will sail in a few weeks.—*Times.*

BUDS.

(*Continued from page* 10.)

IN order to understand clearly the formation of a bud, whether lateral or terminal, it will be necessary to briefly trace its development from this conical mass of embryonic tissue. The earliest differentiation has been detected in the growing point itself, where in the almost homogeneous tissue the three layers of cells which form the various structural systems of stems and leaves are very faintly marked out. These three layers are the *Plerome*, which produces the pith and fibro-vascular system; the *Periblem* from which the cortex or bark arises; and the *Dermatogen*, from which the epidermis or skin is formed. The mode of growth by which these three layers arise is that of *cell-division* and in flowering plants it is confined to the growing point and to another region of similar tissue known as the cambium. The further we proceed downwards from the growing point, which seldom amounts to more than the hundredth part

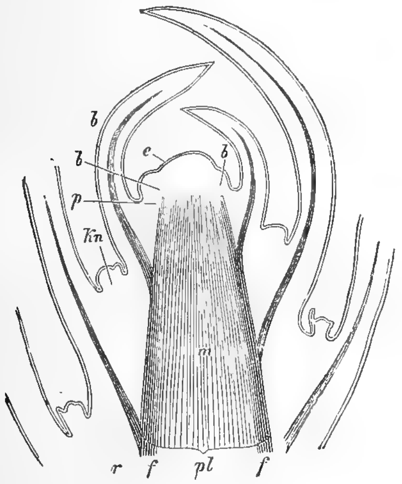


FIG. 3 (after Prantl).—Diagram of a longitudinal section of the stem of a dicotyledonous plant. *m*, pith; *f*, fibro-vascular bundles, both developed from the plerome *pl*, the bundles sending branches to the leaves; *r*, cortical tissue; *e*, epidermis; *bb*, young leaves, two showing their origin from the protomeristem, *p*; *kn*, axillary bud.

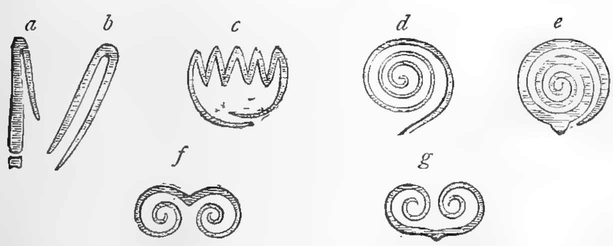


FIG. 5 (after Bentley).—*a*, vertical section of a reclinate leaf; *b*, transverse section of a conduplicate leaf; *c*, transverse section of a plaited or plicate leaf; *d*, vertical section of a circinate leaf; *e*, transverse section of a convolute leaf; *f*, transverse section of a revolute leaf; *g*, transverse section of an involute leaf.

of a millimetre, the more clearly defined do these three layers and the systems subsequently developed from them become, until they attain the readily recognisable cellular and vascular distinctions of form previously described. The leaves are always developed in a regular order, viz., *acropetally*, or from base to apex, as may be easily observed on expansion—and they always take their rise from the outer layer or layers of the *sides* of the growing point before the epidermis is formed, and in their earliest visible condition appear as little roundish or conical swellings, as shown, in figs. 1 *a* and *b*, 3 *b* and *kn*. As before stated, they never arise from the actual apex of the growing point, because their so doing would stop further growth in that direction, as is the case when a stem ends in a flower (lilac and horse-chestnut, fig. 4.) As they form they carry out with them in continuity the

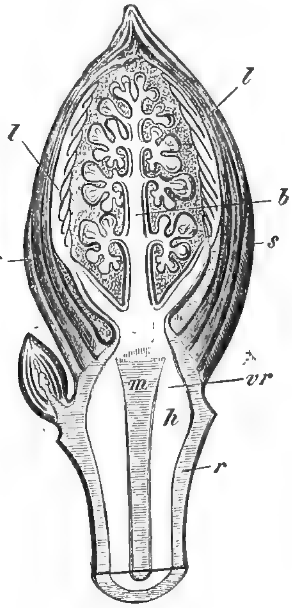


FIG. 4 (after Sachs).—Median longitudinal section through a vigorous winter bud of the Horse Chestnut (*Aesculus hippocastanum*). *m*, pith; *h*, wood and *r* cortex of the shoot axis (*vr*) of the preceding year; *ss*, bud scales; *ll*, young foliage leaves—in the middle are the flower buds. Woolly hairs fill the dotted space.

vascular, cortical, and epidermal tissues of the stem. Thus in our bud we have pith, fibres, and vessels surmounted by an apex of dividing cells from which rudimentary leaves proceed, whilst lower down the leaves

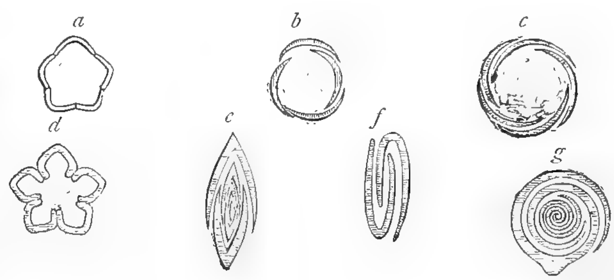


FIG. 6 (afte· Bentley)—Transverse section of buds: *a*, to show the leaves arranged in a valvate manner; *b*, to show imbricate vernation; *c*, to show twisted or spiral vernation; *d*, to show induplicate vernation; *e*, to show eduitant vernation; *f*, to show obvolute vernation, and *g* to show supervolute vernation.

are in a more advanced condition with vascular, cortical (modified) and embryonic systems of their own and embryonic buds in their axils. This is the condition of the structure in autumn, and such it remains during the dormant period of winter until the warmth of spring causes the sap to rise till the plant is gorged by it, and the protoplasm to resume its activity, the whole apparatus of vegetation being again set in motion. The embryonic tissue at the growing point and at the apices of the younger leaves now begins to divide, whilst those cells which have ceased to divide become watery and enter upon the period of elongation by which they receive their outward form and size and which causes that rapidity of growth which is so striking. The older parts commence to undergo that internal differentiation which results in certain alterations in the cell-walls and other partly formed structures—pittings, lignification, etc., and the formation of stomates in the epidermis—that complete growth. Then it is that the leaves rapidly expand, reversing as they do so the order of growth followed when forming in the bud when they curved upwards and inwards closely enveloping the axis, whilst now they curve downwards and outwards. This diversity is due to a curious property of plants known as *Bilaterality* which under certain conditions plays a very important part in their life-history and displays itself in an unequal growth of the sides of different structures, as in the leaves of the bud which when first forming grew more rapidly on their outer and under sides (*hyponasty*), the tension on the opposite side causing them to bend upwards, whilst in expanding they grow more rapidly on their upper and inner sides (*epinasty*), causing them to bend outwards and downwards. The mode in which they are arranged or packed in the bud is interesting, and varies greatly with the species, and is termed *vernation.* If a leaf-bud of any kind—the larger the better—be cut transversely and examined carefully with a hand-lens, each individual leaf will be seen to be folded in a certain way upon itself and also placed in a certain position with regard to the leaves nearest it. In the single leaf the vernation varies from the simple *inflexed* (fig. 5, *a, b*), or folding of the upper half of the leaf upon the lower (Tulip-tree), to the more complex *convolute* (fig. 5 *e*), or rolling of the leaf laterally from one margin to the other, as one would roll paper (apricot and banana), and in the relative position of one leaf to another from the *valvate* (fig. 6 *a*), where the leaf-margins merely touch, to the *supervolute* (fig. 6 *g*), where one convolute leaf is rolled round another (apricot). A most beautiful form of vernation of individual leaves is the *circinnate*(fig. 5 *d*), as seen in the tender coils of the fern. The examination of a series of buds would with a little care and patience be a pleasing exercise, and one calculated to increase knowledge of vegetable form. The folding of the sepals and the petals in flower-buds, known as *æstivation*, is, with a few modifications, very much upon the same plan as that in leaf buds.

Returning to the expansion of the leaves, it may be easily observed that the scales, which are mostly brown and dry, do not expand, except in the forms intermediate between the scale and the ordinary foliage-leaf—but rapidly fall away, leaving scars in the form of small, hard, closely-set rings on the stem. They have admirably fulfilled their purpose of sheltering the "winter-buds" from the severity of the colder months (being absent from the buds of plants growing in warm climates and from those which are formed during the more genial parts of the year, as in herbaceous plants) by many an ingenious contrivance, such as hairs and gummy exudations which render them bad conductors of heat and insoluble in water. Nowhere is this object of protection more beautifully carried out than in the bud of the ordinary Plane, which is completely covered by the hollow base of the leaf-stalk at its junction with the stem, and is only revealed when the winds of autumn bring down the leaves. It will then be found to be wrapped in three coverings, an outer of a gummy waterproof nature, a middle of furry scales, and an inner of silky down. These scales may be compared to those found on tubers and on underground stems; and are in reality rudimentary leaves, transitional stages, between their own form and that of the complete leaf, being of common occurrence. According to Goebel, they consist of chiefly of that portion of the leaf which first arises from the growing point, and is known as the "foliar base," which in an ordinary leaf develops so slightly as to be hardly distinguishable from the fully developed "upper leaf," and if a stalk be present it is generally interposed between the two. This "foliar base shows vigorous growth in the scales of the maple and the horse-chestnut, the ordinary "upper leaf" being sometimes so small as to require the microscope to make it manifest, whilst other forms occur in which the latter is easily distinguishable. To prove the origin of the scale from the "foliar base" Goebel took several young plants of the bird cherry (*Prunus padus*) on the 14th April and lopped off their apexes and part of their leaves. By the 10th of May the axillary buds, which should have expanded next spring, stimulated to premature growth by the excess of unused nourishment, began to develop vigorously and normally; the "foliar base," which usually became scales, being transformed into foliage leaves. This interesting experiment he afterwards confirmed upon the horse-chestnut, the maple, the rose, and the oak. The scales of certain plants are formed from stipules—small foliaceous appendages often found at the bases of leaves —as in the tulip-tree and many species of alder, where the two stipules of the lowest leaf are modified into scales.

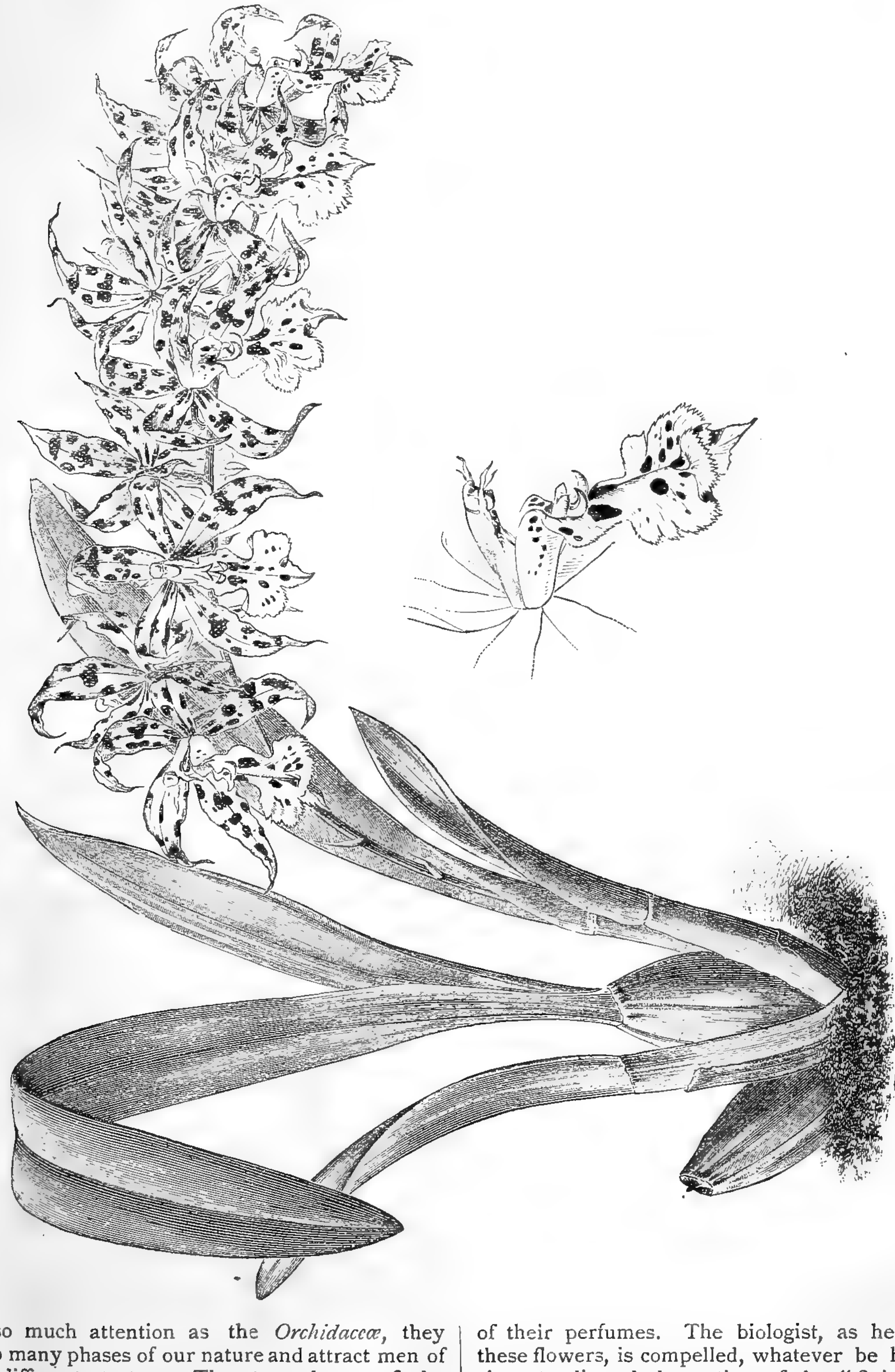
Resuming our study of the development of the foliage-leaves, it will be found that their growth is much more rapid than that of the stem, indeed the *internodes*, or spaces between the *nodes* or attachment of the leaves, in many plants remain as they generally are in the bud, in an undeveloped condition, as in *Nephrodium filix-mas*, or they may be so extremely short as to be apparently wanting, as in plants which exhibit rosettes of leaves (palms, etc.). In other cases, where the leaves are in distant whorls, the internodes are formed immediately after the leaves in the bud. In general, however, the internodes in the fully-formed shoot are well-developed, the nodes having sometimes a constricted and sometimes a swollen appearance, owing to the internal tissue passing off into the leaves, complete rings being formed when these encircle the stem, as in the bamboo and grasses generally, and in some cases the node becomes a separable joint, as found in the common pink.

MIDDLESEX NATURAL HISTORY AND SCIENCE SOCIETY.—This society held its first field-meeting of this summer on Saturday last, assembling at Northwood Station. The members walked through field paths to Batchworth Heath, then skirting Bishop's Wood into Moor Park the walk was continued into Rickmansworth. In the course of the excursion Mr. Thomas Blashill instructed the members on the methods of collecting and keeping wild plants to form a herbarium. Dr. Wharton, who was associated with Mr. Blashill as botanical mentor, contributed in like manner to the instruction of the members.

Natural History.

THE ORCHIDS: WHAT ARE THEY?

THERE are probably no plants, not directly subservient to our bodily wants which, in the present day, win so much attention as the *Orchidaceæ*, they appeal to so many phases of our nature and attract men of the most different tastes. The true lover of the beautiful—we do not here speak of that pseudo-esthetic sect who bow down to sunflowers and dandelions, to marigolds and dog-daisies—when he gazes on an orchid in flower is smitten at first with wonder, which rapidly passes into something verging upon affection. He is simply fascinated by their graceful forms, the purity and the exquisite harmony of their colours, and the delicacy of their perfumes. The biologist, as he contemplates these flowers, is compelled, whatever be his prepossessions to discard the notion of the "fixity of species" as a dream of the past. He sees here hybridism as



ODONTOGLOSSUM BLANDUM (AFTER VEITCH).

much the rule as the exception; he witnesses forms shading away into each other like the colours in the solar spectrum, and he asks at last vainly, What is a species? If he passes from such generalities to details he sees how, as Darwin has shown us, the most wonderful structures are employed for effecting the reproduction of the plant.

The horticulturist finds the management of these flowers in a European climate a task which at once stimulates him by its difficulties and delights him by the success with which his skill is often crowned.

Lastly shall we say that orchids have a particular fascination for the millionaire, and especially for him who has recently arrived at this envied position? A well-stocked, well-managed orchid house, and a constant supply of these lovely flowers for domestic and personal ornament, is proof of wealth even more striking, because more frequently producible, than an overflowing picture gallery. The prices paid for single plants of the rarer and more beautiful species are very high; £500 have been paid for a single plant of *Cattleya mossiœ*, and small shoots of a *Cypripedium* have fetched half that sum. These prices may remind some of our readers of the "tulip mania" which once prevailed in Holland, when fabulous sums were sometimes paid for a single root. There is, however, an essential difference. The "tulip mania" was a development not of horticulture or of flower-worship, but simply of gambling. Bulbs were sold which had no existence, and which were not intended to be delivered. The man who, *e.g.*, bought 100 bulbs of "Semper Augustus"—though, perhaps, not half that number could have been met with in all Holland—expected or hoped that he could in a few hours re-sell them at a profit to some other speculator.

Now in the high prices paid for orchids there is nothing similar. At sales the plants are actually produced, examined, and, when sold, duly delivered. Their costliness is due to their wonderful beauty, and to the difficulty of procuring and preserving many of the finest kinds. If the nurseryman is to send out experienced plant-hunters to the forests of Burmah or Borneo, and to pay for all the appliances needful for conveying home to England the precious booty safe and sound, he must naturally demand a fair profit on his outlay. Nor do we think that the passion for orchids is a mere temporary freak. If it be true in the somewhat hacknied words of Keats, that "A thing of beauty is a joy for ever," these gorgeous plants will always be cherished by all who have the means to acquire them, or the skill to keep them in healthy growth.

We must remember that we are here speaking, not of a single genus, but of a whole family of plants, including many genera and a whole multitude of species. If we make no attempt at their enumeration it is because, as we have already intimated, the task of drawing a definite line between species and species puzzles even the most eminent botanists. But so widely do they differ in their structure and habits that a non-botanist would scarcely think of referring them to the same group. Who, for instance, would think that the common spotted meadow-orchid—as abundant in the pastures of "flowery Suffolk" as is the daisy in the neighbourhood of London—could be a near ally of the magnificent *Odontoglossum blandum*, of which we give an illustration? Yet such is the case. The orchids of Europe, North America, and the temperate parts of Asia grow in the soil after the normal fashion of plants. The orchids of the tropics and of certain exceptional temperate regions, such as the eastern coast of Australia, Tasmania, New Zealand, and Japan, are *epiphytous*, that is, they grow, not in the soil, but upon the trunks of trees or rocks to which they attach themselves. It is curious that the species which thus maintain themselves should be larger and more luxuriant than the kinds growing in the soil, and the most absurd theories have been broached in explanation. Some have even suggested that these plants have the power of manufacturing the mineral matter which they, in common with all plants, require out of air and water! The fact is that the tree-trunks and the rocks themselves supply such matter. Decaying leaves, and other vegetable *débris*, and, above all, the dust of the earth, which can nowhere be excluded, lodge among the root-stems of these plants and supply all the mineral mattter which they need.

The more splendid orchids, therefore, are parasites. Unlike the common run of parasites, however, they are beyond comparison more beautiful than the beings upon which they feed. This may teach us the danger of making sweeping assertions, based, perhaps, upon a number of facts, but leaving others out of account.

In our next article we shall notice some of the more important groups of this wonderful family.

(*To be continued.*)

Bifurcated Palm-trees.—M. A. E. Göldi writes from Rio de Janeiro to *La Nature* to this effect:—"You published, on March 3rd of this year, an article on a bifurcated palm-tree at Cayenne. Such cases are not so rare as you seem to indicate. Here, at Rio, of ten specimens of an ornamental palm, very common in the gardens of the Brazilian capital, four are certainly bifurcated. It is a palm of the genus Areca, probably *A. arundinacea*, known colloquially as '*palmeira bambu*.' In the genus *Oreodoxa*, of which there are many splendid specimens in Brazil, bifurcation is less common, but more than one instance is known. Professor Haeckel, of Jena, on his return from Ceylon, spoke of a bifurcated cocoa-nut tree which had been shown him there as something remarkable."

Natural Food for Young Trout.—A writer in the *Field*, who uses the unpardonable signature of "Detached Badger," cautions trout-breeders against introducing into their tanks any of the parasitical forms of Entomostraca. One of these, *Argulus foliaceus*, he pronounces the most prevalent and deadly enemy of fresh-water fish. Unfortunately, it has the power of leaving the fish upon which it is feeding and swimming freely in the water; hence, when once introduced into a pond containing young fry, it produces a great spread of disease. The same writer points out that the Entomostraca require a due supply of food in the tanks.

Curious Case of Mimicry.—Mr. J. B. Steere (*American Naturalist*) observed in Southern Mindanao a very curious case of mimicry. Among the lizards was a flying species (*Draco*), very abundant on the cocoa-nut trees. On opening the wing-membranes one could not help noticing a likeness to a butterfly both in the shape of wings and in the colouring of blue with red spots. This peculiar colouring may aid the lizard both in escaping its enemies, the hawks, and in capturing its own insect prey.

NOTES ON THE BLACKBIRD.—Mr. H. Kerr (*Newcastle Weekly Chronicle*) mentions, in proof of the imitative disposition of the blackbird, that a wild one was found mimicking the crowing of a cock, and flapping its wings in the style of chanticleer. Mr. Kerr scarcely puts the case fairly when he blames the "ignorant gardener" for his displeasure at this bird's "helping itself to *a little* ripe fruit." Like many other species, the blackbird spoils not "a little," but a great deal, by pecking at the sunny side, when earwigs and flies creep into the holes and complete the mischief. For all this, we would spare every bird except the sparrow.

SWIFTS FLYING BY NIGHT.—Correspondents both of *Nature* and of the *Field* record instances of swifts remaining on the wing through a considerable portion of the night, if not through the whole.

A TRUE TAIL IN A HUMAN SUBJECT.—A case of this rare phenomenon of reversion is stated on the unimpeachable authority of Professor St. George Mivart. He was called in to a consultation on the safety of amputating this superfluous member, which was duly effected. The tail was 2½ ins. long, and was no tumour, mole, or other morbid excrescence, but had true joints, like that of a baboon.

POISONOUS HONEY.—Certain species of bees in Boliva are said to collect a poisonous honey, gathered doubtless from dangerous plants. Others are said by a writer in *Cosmos* to yield a honey endowed with strengthening properties, but in return their black and hard wax has the "the most fatal properties." What is the exact nature of these "fatal properties" the writer does not say, but as we do not eat wax it can be of but little consequence.

THE SERPENT CHARMERS OF THE EAST.—F. Mocquard, writing in *La Nature*, suggests that cobras and other venomous serpents may possibly be thrown, by the manipulations and the monotonous music of the jugglers, into a hypnotic crisis. They are said to become stiff and inflexible like a rod—a state, doubtless, of catalepsy. M. Mocquard suggests that these phenomena deserve a serious scientific investigation.

THE ACTION OF PATHOGENIC MICROBIA ("DISEASE GERMS").—M. Arloing had previously observed that the development of the microbe of the contagious pneumonia of cattle determines the production of a special substance, the most striking properties of which are those of the diastases. He has just announced to the Academy of Sciences that he has obtained the matter in question in a state of purity by precipitating it with absolute alcohol. It is soluble in water, and the solution, on injection into a vein, occasions the same symptoms as the disease germ itself.

THE HESSIAN FLY.—This pest has been again noticed in our cornfields, and on Wednesday Miss E. A. Ormerod received some infested stalks of barley from Mr. George Palmer, jun., of Revell's Hall, Hertford, the gentleman who was the first observer of the pest in England.

THE AQUARIUM OF BANYULS.—According to a paper read before the Academy of Sciences by M. de Lacaze-Duthiers *Murex trunculus* and *Eledone moschata* have deposited ova, a fact never witnessed before in captivity. He exhibited a photograph of a colony of little *Alcyonia*.

THE CANON WREN.

LONG ago, when our country was comparatively new, and naturalists few and far between, hundreds of birds whose notes had never been heard by men of science flitted through the woods, and whose songs, when heard for the first time, were a source of pleasure seldom equalled, and occasioned a feeling akin to idolatry.

Owing to the efforts of ornithologists, this state of affairs no longer exists. True, there is still much to be accomplished in the study of the singing of our birds, but to hear something comparatively new, something not constantly heard of and talked about, it is necessary to enter the more remote and isolated portions of the country, and to traverse the mountains and valleys seldom trodden by man. It is in such localities as this, in the southwestern part of the United States, that the cañon wren (*Catherpes mexicanus conspersus*) is to be found. Here, no matter how lonely, darksome, or dreary the vale, no matter what dearth of life is otherwise to be found, the clear, melodious song of this bird breaks forth from the gloom and thrills the very soul of the listener as with something holy. This is entirely different from the song of any of our birds, and is as marvellous for its character as for its clearness and strength, consisting of a series of eight or ten notes, descending regularly as does the musical scale until the lowest note is reached, each clear and distinct, but prolonged, so as to glide smoothly into the next.

I remember well the first time I heard it. I had been climbing the "Bee Rocks" near Meridian, Texas, and on reaching the summit paused a moment for breath and to rest. From a considerable elevation I looked across the Bosque Valley to the hills on the opposite side, and along the river, for a distance of twenty miles in either direction. The bed, owing to a three years' drought, was dry, save for a few stagnant pools of water, and the valley, although still of a sickly green, contained but little animal life.

In the air above circled countless numbers of vultures, while on the edge of the cliffs perched swarms too gorged to fly, but at times dispelling the monotony by shifting their location in long, awkward hops. The whole presented a scene similar to some of those described by Dante, and a more gloomy and desolate spot would be hard to find. While comparing it with a landscape viewed from a similar location in central New Hampshire, the wonderful note of the cañon wren burst upon the air. It was repeated several times at intervals of about three minutes, when it was answered by another lower down on the cliff. Both sang for some moments, then all was hushed as before. That the rocks had now a new interest, and had assumed a different aspect, can be readily imagined. For some time I waited in vain for it to be repeated, when of a sudden it burst forth again, seemingly directly beneath me. Crawling to the edge and peering over the cliff, the author was discovered some distance below flitting from rock to rock, pausing occasionally to give utterance to its song, then resuming its occupation. To descend to a point about on a level with the bird and conceal myself was the work of a few moments. Presently, with a "chip" and flutter, the little songster entered my retreat, visiting every nook and cranny, peering into every crack and crevice in search of insects. Yet it never for a moment lost sight of me. Coming at times to within a few feet of my hands, it would dart to the opposite side of the cavern and view me from another quarter. Whether it possessed that peculiar, hoarse, chattering note common to most of the family, I was at a loss to know, until, by accident, I moved slightly, when, with a sudden movement, it dashed across the open space, plunged into the bushes, and descended gradually to the bottom of the valley, scolding to itself all the way. During the next half-hour a dozen or more individuals were heard, and many others were undoubtedly in the vicinity. Descending now some fifty feet to a shelf which runs the entire length of the rocks, I followed it for some distance, and was pleased to note a number of the birds in question clinging to the walls, darting into the air and seizing insects in the manner of the tyrannidæ, disappearing from view for a time, while they searched the interior of some dark retreat, and appearing again often where least expected; on one occasion I observed one enter an orifice in the rocks some twenty feet distant, and, while watching closely for its return, was amused to have it dart from a hole directly before my face. The bird was fully as surprised as myself, and considerably more frightened, for it dashed around a neighbouring bluff and went some distance down the cliffs.

This closed my experience with them until later in the season, when I again met a few in the vicinity of Comanche Peak, in Hood country, and again, a week later, on Paluxy Creek; but it was now late in the fall, and their voice had lost much of its melody and richness. They are never, I believe, to be found at any great distance from the gorges and cliffs, which are their favourite haunts, and while the beauty of other localities is enriched by the songs of hundreds of musical little throats, it is reserved for the present species to lift in part and to cheer the gloom which for ever overshadows some of Nature's mightiest and grandest works.—*Scientific American.*

Reviews.

Notes on Inorganic Evolution. By E. A. Ridsdale. London: H. K. Lewis.

If evolution is in truth a primary law of the universe, we should be able trace it, not merely in stars and in living beings, but in the materials of which both stars and living beings consist—that is, in chemical compounds, or, perhaps, even in those elements from which such compounds are put together. Just as at present scientific men are seeking to trace out among organisms the counterpart of the periodic law of Newlands and Mendeleeff, so they are also searching for evidences of evolution in the chemical sphere. Now, here Mr. Ridsdale seems to us to have thrown a new and valuable light upon the question. It is generally admitted that the flora and fauna of the world consist of those plants and animals which have survived as being most fully in harmony with the totality of the circumstances among which they are placed. But can we find anything not identical but corresponding in the mineral world? Mr. Ridsdale tells us that the ruling principle here is the "survival of the most inert." Says the author: "When any new compound is formed, it is produced by reason of the greater affinity of the constituents of the new compound for each other than for the constituents of the older bodies of which they formerly made a part. . . . Bodies whose constituents have little affinity for each other tend to be broken up, and those compounded with stronger affinities to persist." Hence bodies held together by strong affinities will accumulate, whilst those held together by feeble affinities will gradually disappear. But it is further remarked that bodies having for each other very strong affinities may have still stronger ones for some other body or bodies, so that a body thus compounded may have in the long run a smaller chance of remaining unchanged than a body less strongly held together with weaker elemental affinities. Hence the body which is, as a whole, the most inert, is most likely to survive. The author shows—what will scarcely be controverted—that any such gradual "selection of the most inert" must have been exceedingly slow. He thinks that the evidence to be found is, upon the whole, favourable to this supposition. He reminds us that there is a constant tendency for barium salts to become sulphates; magnesium and aluminium salts to form oxides and silicates; silver salts, chlorides; lead salts, sulphides, etc. The inert salt, when once formed, except under abnormal conditions, remains, whilst any other salt, how often so ever it may be formed, is sooner or later broken up.

From these facts—for so far, at least, what he advances may be accepted as fact—certain striking conclusions follow as being, though not demonstrated, yet analogically probable. What are those bodies which we call simple or elemental? Are they not possibly—even probably—compounds which under the existing conditions of things are, *as wholes*, more inert than any other class of bodies, and thus persist? Says Mr. Ridsdale very happily:—"Every chemical body is 'elemental' to some set of conditions, or it could not exist, and an element *may* only be a body stable under more extreme conditions than usual"—in other words, more inert. Pointing out that in any group of the elements, the most active are those with the lowest atomic weights, and *vice versa* (*e.g.*, fluorine as compared with iodine) he suggests as possible that in each group of the elements those with the lowest atomic weights were formed first, and then those with higher atomic weights. Here, as the author intimates, we find ourselves running, not merely parallel to the law of Newlands and Mendeleeff, but to the more recent work of Mr. Crookes, F.R.S. On comparing the workings of this principle of the "survival of the most inert" with those of organic evolution, we can scarcely fail to find a number of very instructive resemblances. Many more passages in this pamphlet, brief but pregnant, deserve careful consideration. But we will merely quote the author's concluding remarks:—"That the various forms of matter are not radically distinct has long been supposed; that the early condition of the universe was fiery and gaseous, has almost passed the domain of theory; that our solar system at least is gradually tending to an inert or dead condition, is generally believed. Any hypothesis that can correct and explain such varied beliefs without running counter to evidence is worthy, at any rate, of a hearing."

Journal of the Franklin Institute of the State of Pennsylvania. Vol. cxxv., No. 6. June, 1888.

By far the most interesting paper in this issue is the report on water-spouts off the Atlantic coast during January and February of the present year, drawn up by Mr. Everett Hayden. These alarming and sometimes dangerous phenomena have been unusually plentiful, both on land and sea. Our readers will remember that two water-spouts—perhaps the German term "Wolkenbruch," or, as it may be rendered, "cloud-burst, is more applicable to such cases when they occur on land—have been recorded in Yorkshire (SCIENTIFIC NEWS, page 583). These spouts Mr. Hayden considers as special cases of whirlwinds and tornadoes, but on a much smaller scale. The general underlying principles he considers to be as follows:—A layer of warm moist air at the surface of the ocean happens to have above it a layer of cooler, drier air. This condition of things is one of unstable equilibrium, and sooner or later the warm light air at the surface rises through the cooler air above. This process sometimes takes place gradually and over a large area, but at other times it is more local, and there seems to be formed in the upper layer a break or opening through which the air of the lower stratum drains upwards, as through a funnel. When the differences of temperature and moisture, and the supply of warm moist air at the surface are very great, this action becomes intense, and this intensity is increased by the fact that as the air rises its moisture is condensed, the latent heat thus liberated adding to the energy of the rising column of air. As this surface air rushes in and escapes upwards through the opening thus formed in the upper layer, it takes up a whirling motion, the velocity of which is greatest towards the centre of the funnel, and a suction or partial vacuum is created, as indicated by the low reading of the barometer towards the centre of a cyclone.

When a whirlwind is thus formed over the ocean, water is often drawn up the centre of the whirl some distance, owing to the suction created, and at the same time the moisture in the air is condensed as it rises, so that the name "water-spout" is very applicable. Indeed, sometimes a spout will burst over a vessel and flood her decks with water, as a cloud burst does on a mountain side. The damage done, however, may exceed flooding. Captain Strandt, of the American bark *Reindeer*, as here stated, reports that on February 11th a heavy water-spout passed over his vessel, when under full sail, and dismasted her to below the heads of the three lower masts. This catastrophe happened near the "still vexed Bermöothes." But how would the ship have fared had the spout been like the one at Langtoft, which bored through the soil down to the solid rock?

During the two months of January and February, and within a comparatively short distance of the American coast, spouts are here recorded as having been seen on fourteen occasions, in one instance nine being observed within half an hour. In other cases four or six were seen at once. Capt. O'Leary, of the British steamer *River Avon*, on February 28th saw, in latitude 39° 30′ N. and longitude 57° 20′ W., "What he took to be a heavy squall to the south-east. Upon looking at it with his glass, he saw that it was a whirlind raising the water to a great height. It must have been *over a mile in diameter*, but he hesitates to even estimate the height to which the water was raised, or the size of the spout."

Mr. Hayden asks for sketches, or, if possible, photographs of these phenomena, together with notes of the temperature of air and water, barometric readings, direction and force of wind, and changes in each, if any, while the spout lasts.

LAND AND FRESH WATER MOLLUSCA OF LEICESTERSHIRE.—We have received from Mr. H. E. Quilter, M.C.S., a list of the mollusca of Leicestershire, indicating their habitat; the list contains sixty-three species and twenty-seven varieties.

Abstracts of Papers, Lectures, etc.

GEOLOGICAL SOCIETY OF LONDON.

AT the meeting held on June 20th, W. T. Blanford, LL.D., F.R.S., President, in the chair, the following communications were read:—

"On the Occurrence of Marine Fossils in the Coal-Measures of Fife." By James W. Kirkby, Esq. Communicated by Professor T. Rupert Jones, F.R.S., F.G.S.

This paper recorded the discovery of fossils of good marine types in the Fifeshire coal-measures. This coal-field is of limited extent, the coal-measures dipping under the sea towards the east and south. The prevailing fossils are those characteristic of the coal-measures in other districts, *Anthracosia*, *Anthracomya*, *Anthracoptera*, *Spirorbis*, many fishes, and some few Amphibian remains. Lately a sinking was commenced in the Upper Red beds, below which, and just above a thin band of poor coal, a thick bed of dark shale was passed through, which proved to be tolerably fossiliferous. *Lingula*, *Murchisonia*, and two species of *Bellerophon* occurred. This horizon was subsequently proved elsewhere in the district, and furnished the following fossils from three localities, namely, *Strephodus sauroides* (?), Ag. (teeth and scales); *Rhizodopsis*, sp. (scales); Palæoniscid scales; *Diplodus gibbosus*, Ag.; *Mesodomodus*, sp. n.; *Petalodus Hastingsiæ; Discites rotifer* (?), Salt.; *Discites*, sp. (with longitudinal ribs)· *Discites*, sp. (smooth); *Orthoceras attenuatum* (?), Flem.; *Bellerophon Urii*, Flem.; *Murchisonia* (*Aclisma*) *striatula*, De Kon.; *Sanguinolites*, sp.; *Productus semireticulatus*, var. *Martini*, Sow.; *Discina nitida*, Phill. *Lingula mytiloides*, Sow.; *Lingula squamiformis;* crinoid stems (*Actinocrinus ?*); plant-remains (obscure).

Reference was then made to the occurrence of similar fossils in the same formation elsewhere, and particularly in the West of Scotland, North of England, and Lancashire. The author concluded, from the frequency of the beds containing true marine remains, that the coal-measures were formed in low-lying areas; and that, when the land was slightly depressed, at times the waters of the sea had access to such spots, bringing back species of shells and crinoids that had existed in the carboniferous-limestone ocean of an earlier period.

In conclusion, the author observed that no marine deposits have been observed as yet in the upper red beds of the Fife or other Scotch coal-measures.

"Directions of Ice-flow in the North of Ireland, as determined by the observations of the Geological Survey." By J. R. Kilroe, Esq. Communicated by Prof. E. Hull, F.R.S., F.G.S.

While the striæ S.E. of a line drawn from Strangford Lough to Galway Bay all trend in one direction, two sets of striæ occur N.W. of that line, which are generally at right angles to each other, and are frequently seen upon the same rock-surface. The direction of these is N. by W. in Antrim and Londonderry; N.W. over the highlands of Fermanagh; and N.E., N., and N. by W. in Donegal, etc. That of the second set is W. 25° S., swinging round to W. in Donegal and S.W. towards Galway Bay, and is strikingly persistent throughout. Besides these, a very few striations occur which do not conform to these directions, and are attributable to local ice-flows.

The second set of striations was referred to the ice of the *Scottish Glacial System*, and evidence was cited from the researches of Messrs. Symes and McHenry, Dr. Geikie, and others in support of this view, which is confirmed by the relative positions of the boulders and their parent rocks. Striæ bearing westward have been observed at a height of 1,100 feet in co. Mayo.

The effects of the *Irish Glacial System* have been considered by the Rev. W. Close, Mr. G. H. Kinahan, and Prof. Hull. Striations occur up to 1,340 feet in Donegal. The ice of this system flowed in a general S.E. direction to the S. of the axis.

With regard to the relative age of the two set of striæ, it is observable that those bearing northward are by far the most numerous; so that although it is reasonable to suppose that as a considerable accumulation of snow and ice obtained in the Irish area whilst the Scotch system was gathering its maximum strength, the striations produced by this gathering would be largely effaced by the westward-flowing Scotch ice; and that, after the decline of the latter, an independent Irish *mer de glace* flowed northward and southward, finding its axis of movement in the great central snow-field.

"Evidence of Ice-Action in Carboniferous Times." By John Spencer, Esq., F.G.S.

The author combated the notion that there is any *a priori* improbability in the action of ice during the period in question. In the case under consideration, of the two agents, land-ice or floating-ice, he was inclined to adopt the latter, as having been the cause of the phenomena he described. The bed affected is the Haslingden Flag-rock, a member of the Millstone-Grit series, which is directly covered by a shale of the same series. The surface of this Flag-rock is largely striated, the striæ having a N.E. and S.W. direction, and being nearly parallel. The area exposed is 200 square feet. The Flag-rock dips to the east at an angle of 30°; but there seems no possibility of these striæ having been produced by landslips or local disturbance. A quarry on the same horizon, near Rochdale, exhibits similar phenomena. As collateral evidence of ice-action, he alluded to the boulders frequently found in the coal-seams.

In the subsequent discussion, Mr. Topley said the question of the striæ was difficult to decide; but he thought the reference to boulders in a coal-seam a thousand feet above did not help matters. He considered the appearances due most probably to movement of the nature of slickensides. It was too hazardous to put it down to ice-action.

"The Greensand bed at the base of the Thanet Sand." By Miss Margaret I. Gardiner, Bathurst Student, Newnham College, Cambridge. Communicated by J. J. H. Teal, Esq., M.A., F.G.S.

This bed may be seen between Pegwell Bay on the east, and Chiselhurst on the west, and a somewhat similar bed occurs at Sudbury, Suffolk. An examination of the Kentish layer showed it to consist of 45 per cent. of quartz, 15 per cent. of glauconite, and 40 per cent. of flint. Amongst the rarer minerals are felspar, magnetite, spinel, zircon, garnet, rutile, tourmaline, actinolite, epidote, and chalcedony; and there are a few microscopic organisms, either Radiolarians or Diatoms, and some Foraminiferal casts.

The Sudbury greensand has 75 per cent. of its grains consisting of glauconite, and of the quartz and flint-grains only 10 per cent. are flint; several of the rarer minerals found in Kent occur here also.

The large flint-percentage in the Kentish grains was alluded to in support of the existence of an unconformity at the base of the Tertiary deposits of that area; and the relatively small percentage of flint in the sands now being formed along a very similarly situated shore, was suggested to be due to the drifting of *debris* derived from the coasts composed of Tertiary and Wealden rocks, which became mixed with the material brought down by the Thames.

"On the occurrence of *Elephas meridionalis* at Dewlish, Dorset. By the Rev. O. Fisher, M.A., F.G.S.

The author's attention was first drawn to this subject on seeing two molars of an elephant in the Blackmore Museum labelled "Dewlish, Dorset." He at once attributed them to *E. meridionalis.* Subsequently he ascertained that they were part of a find made in 1813 by a Mr. Hall. Dr. Falconer, from rubbings, attributed the teeth to *E. antiquus*; and Dr. Leith-Adams would not allow that they belonged to *E. meridionalis*, because that species had never been found so far west. Last year the author and Mr. Mansel-Pleydell went to Dewlish, and the latter has since continued the workings. The remains have been found high up on the face of a steep chalk scarp facing west, ten feet below the brow and ninety feet above the existing stream, in such a position as to suggest that the deposit was the result of an undercut of the stream when it flowed at a higher level.

"On Perlitic Felsites, probably of Archæan age, from the flanks of the Herefordshire Beacon, and on the possible Origin of some Epidosites." By Frank Rutley, Esq., F.G.S.

The author has previously described a rock from this locality in which faint indications of a perlitic structure were discernible. In the present paper additional instances were enumerated and a description was given. The perlitic structure is difficult to recognise, owing to subsequent alteration of the rock.

The author suggested, from his observations, that felsites, resulting from the devitrification of obsidian, quartz-felsites, aplites, etc., may, by the decomposition of the felspathic constituents, pass in the first instance into rocks composed essentially of quartz and kaolin; and that by subsequent alteration of the kaolin by the action of water charged with bicarbonate of lime, and more or less carbonate of iron in solution, these may eventually be converted into epidosites.

He regarded it probable that the rocks are of later Archean or Cambrian age.

"The Ejected Blocks of Monte Somma. Part I. Stratified Limestones." By H. J. Johnston-Lavis, M.D. F.G.S.

Introductory.—The author referred to the Hamilton collection, now in the British Museum, and to the work of Professor Scacchi, who enumerates 52 mineral species as having been found in the ejected blocks, and indicated the importance of these from a geological and volcanological point of view. His own collection contains over 600 specimens, showing the graduation from unaltered limestones, through various stages of change into numerous varieties of "true metamorphic rocks," which, in their turn, shade into igneous rocks more and more approaching the several modifications of the normal cooled magma of the volcano. Moreover, such rocks come from depths where they have not been affected by alterations of a secondary nature.

He then gave a classification of the varieties of ejected blocks. The tertiary rocks are but slightly metamorphosed, whilst the limestones of cretaceous or earlier age afford an almost unlimited series of mineral aggregates. Physical changes have converted them into carbonaceous and saccharoidal marbles; next oxides and aluminates have separated, and silicates have been introduced. Such rocks come under the definition of *accidental* ejectamenta. They are only ejected when the apex of the crater-cavity, formed by an explosive eruption, extends below the platform of the volcano into the underlying rocks. He then traced the history of the eruptions of Somma-Vesuvius through divers phases, showing that it was only at a comparatively late period that limestone fragments were blown out, though this had taken place long before the Plinian eruption. The stratified limestones have been chosen for the first part of this paper, because their original lithological structure acts as a guide as we proceed from a normal limestone to its extreme modifications.

Part I.—The character of the limestones which underlie the platform of Vesuvius may be studied in the peninsula of Sorrento, where the mass attains a thickness of 4,700 feet. They are magnesian in varying proportions. A table was given showing twenty-seven analyses, made principally by Ricciardi, the amount of MgO ranging from 1 to 22 per cent. Silica rarely exceeds 2 or 3 per cent., whereas in the greater number of limestones it is absent. The bituminous matter, though a powerful colouring agent, usually exists in quantities too small for estimation, but sometimes reaches 3 per cent. Such are the materials out of which the extraordinary series of silicate-compounds have been developed, and as these materials of themselves could not form peridotes, micas, pyroxenes, etc., it is clear that the silica, alumina, iron, fluorine, etc., must have been introduced from without, viz., from the neighbouring igneous magma. The author then discussed the question of the probable methods, being inclined to favour the notion of vapour in combination with acid gases.

The bulk of the paper was occupied with a detailed description of the microscopic structure of these stratified limestones and their derivatives. The author remarked that the same metamorphic changes may be traced on a much grander scale amongst the ejected blocks, and hinted at the similarity of these changes to those of contact-phenomena as seen elsewhere, and even of regional metamorphism, the two main factors to be considered being the composition of the rock to be acted upon and that of the magma acting.

The changes which ensue in an impure limestone are, in the first place, the carbonisation of the bituminous contents, which are converted into graphite; and a kind of recrystallisation, approaching the saccharoidal structure, seems to have taken place, although the stratification, etc., is preserved. A few grains of peridote now begin to make their appearance, chiefly as inclusions within the calcite crystals, and thus by degrees the results already recorded are effected. In the early stages only is the metamorphism selective. The order in which the new minerals seem to develop is the following:—

(1) Peridote, Periclase, Humite.

(2) Spinel, Mica, Fluorite, Galena, Pyrites, Wollastonite.

(3) Garnet, Idocrase, Nepheline, Sodalite, Felspar.

Many of these minerals are crowded with microliths, which there is reason to believe consist of pyroxene.

MANCHESTER CRYPTOGAMIC SOCIETY.

At the meeting held on the 18th June, Dr. B. Carrington, F.R.S.E., in the chair, Mr. W. H. Pearson exhibited a collection of mosses and lichens from Jamaica, which had been fowarded by Mr. Cockshot for the Society's inspection. Amongst the lichens Mr. Bowers pointed out specimens of *Parmelia perlata* in fruit. This is a British species, but is always found barren in this country. The collection had been made by Miss Eglinton in the neighbourhood of Kingston, Jamaica. Mr. Pearson also exhibited a collection of Hepaticæ from New South Wales, collected by Mr. Thomas Whitelegge, of the Australian Museum. These had been described, and drawings made by Dr. Carrington and himself, and published by the Linnæan Society of New South Wales. The authors presented a copy to the Cryptogamic Society. Another interesting collection shown by Mr. Pearson was a series of specimens of the Hepaticæ of Queensland, sent by Mr. C. Wild, a former member of the Society. They had been identified for the most part by Herr Stephani, and two had been named by him in honour of the discoverer, Mr. C. Wild, now resident in Queensland.

Mr. F. Bowers exhibited specimens of the Hepaticæ collected by himself during the excursion of the Yorkshire naturalists in the Saddleworth district on Saturday last; and Mr. Pearson exhibited specimens of *Marsupella stableii* which he had found during Whitsun week near Cwm Idwal, North Wales, this being a new station for this rare hepatic.

Mr. William Forster showed a pan of young ferns from his fernery, which was most interesting, showing as it did the reproduction of ferns without the intervention of the developed spore (Apospory). The fern frond experimented upon was *Athyrium filix fœmina*, var. *Plumosum elegans*, which was laid flat upon the soil about three years ago, covered with a sheet of glass. The young ferns were now showing themselves, having sprung from the veins of the old frond so laid down.

Mr. Whitelegge, of Sydney, sent a specimen of a handsome moss, *Spiriden muelleri*, in fruit, which he had collected during a recent scientific expedition to Lord Howes Island. It is a large moss, growing from eighteen inches to two feet long.

EDINBURGH AND GLASGOW GEOLOGICAL SOCIETIES.

These societies had a joint excursion on Saturday to the Camps limestone quarries and the mineral oil works at Oakbank, in the vicinity of Mid-Calder. The quarries were first visited. The rock quarried forms the outcrop of a basin-shaped deposit of very finely-banded limestone, the works following the dip at a pretty sharp angle. A roof eight feet thick, forming the upper layer of the bed, and lying under a tough glacial till, has been left by the workmen, along with massive columns at intervals of about twenty feet; and on entering the cavernous penetralia one is strongly reminded of the ancient temple excavations found in Mesopotamia and Armenia. The oldest and deepest quarry could not be entered: it has been unworked for some time, and has filled with water;

but preparations are being made by Mr. Torrance, the manager, to have the water pumped out, and operations started again. The limestone is a hard, beautifully laminated rock. It was very likely deposited in a small loch into which a stream flowed whose waters were highly saturated with carbonate of lime, which had been precipitated owing to the escape of carbon dioxide and evaporation. The spring had likely been of volcanic origin. Very few fossils were found by the party. The well-known carboniferous plants are of course those that characterise the bed, and a few slabs with scales of lepidodendra and the allied genera were seen, mostly on sheets of shaly blaze that crumbled on being touched. One quarryman brought forward in triumph what he described as a fossil—a small slab studded with crystals of calcite. The party were taken to the office attached to the quarries, and were there shown a few of the fossils said to have been found in the beds. The chief specimen was a well-known brachiopod, *Producta gigantea*, a marine fossil, which, it turned out, had come from Kirkcaldy. The museum also contained lumps of dolomite, steatite, copper and iron ore—from Norway. After inspecting the quarries and these products, the company went on to the oilworks at Oakbank, and were shown over the works and initiated into all the mysteries of that complicated process of chemical decomposition by which all the various commercial products of shale are elaborated.

GEOLOGICAL CLASS, EDINBURGH UNIVERSITY.

The last excursion for this session took place under the guidance of Professor Geikie to Innerwick on Saturday. After examining the carboniferous beds at Innerwick, the class proceeded along the coast to the cove, where were seen the stacks and arches produced in the old red sandstone by marine erosion, also some fine sections showing the false bedding. They afterwards visited Siccar Point, where one of the finest examples of unconfirmity in Scotland between the old red and silurian was inspected. The crumpling and folding of the latter, and their subsequent long exposure to denudation before the deposition of the sandstone were clearly demonstrated.

BEWICKSHIRE NATURALISTS' CLUB.

The second field-meeting of this club was held at Kirknewton on the 27th ult. A visit was paid to the pele tower at Heathpool Farm; very little of the tower is left, but the remains of an old spiral staircase attracted much attention from the size and condition of the stones. A move was next made for Coupland Castle, now composed of an old pele tower and an adapted farmhouse, with a modern building intervening. A fireplace in the pele tower bears date 1619. The party then returned to Kirknewton and inspected the curious church. There is evidence of a Norman edifice having stood on the same site. During the times of Border strife that building was destroyed, and for some time the site remained unoccupied. Subsequently a pele tower was erected, and in a more peaceable period a second church was erected, the vault of the tower being used for the chancel, a feature which makes the edifice peculiarly interesting.

The Parisian Bill of Fare.—The consumption of horse-flesh in Paris for the year 1887, according to *La Nature*, exceeded eight million pounds.

THE SOCIAL CONDITION OF THE BABYLONIANS.

Abstract of a Course of Lectures delivered by Mr. G. Bertin, M.R.A.S., at the British Museum.
Fourth Lecture—Laws.

When a new nation is formed, either by conquest or by revolution, it generally adopts the laws of the preceding society. The Semites, however, when they invaded Mesopotamia found only savage populations, and they brought from their first home no codified laws, for as they were divided into small tribes or kingdoms, traditional customs and what may be called natural laws had sufficed; nor did the arrival of the Akkadians bring any change to this state of things. After the two races had amalgamated there appears to have been an attempt at a codification of the unwritten laws. Whether it was the work of a wise king or that of a philosopher, as happened in Greece, or that of a number of legislators deputed by the people, we are not able to say. The date of this codification is even uncertain, it can only be said that it was anterior to Sargon of Agade (about 3,000 B. C.), and that it was probably the work of Akkadian speaking legislators, for these laws, or rather precepts, were written in Akkadian and translated by order of Sargon.

In these precepts—for they are more precepts than laws—the legislator considers man under his three most important aspects: first as a private individual, second as an agriculturist, third as a trader. The two first treatises or tablets have come down to us nearly complete. In the first are stated the duties of man in his private life; these we have already considered. In the second are enumerated the rights and duties of the agriculturist, the methods he is to use in the cultivation of his field, and the different kinds of tenures; the tablet gives also a list of the furniture, implements, utensils, etc., which constitute the plant of a farm. The third tablet, though much mutilated, appears to be a treatise on property. It speaks of the different kinds of holdings by contract for a limited period, or for life, or by purchase without reservation; of the possession of slaves, horses, and other animals; of the power of the owner had over them, and of the way in which other people were to assist him in capturing fugitive slaves; and of the defects making a contract void. It treats also of payments, loans, and interest on money.

These three treatises were the base of the Babylonian laws; they formed the first text-book of the scribe in his early education, and were always consulted by the interpreters of the law.

With the progress of the society new wants were felt and new points were raised in the courts of laws; these were met by edicts of the king or orders of the governors of towns; but more often the new points raised in the courts of law were decided in the same way as with us; the sitting magistrate, with the assistance of some of his colleagues, after a careful examination of the case, decided according to the best of his ability and gave judgment. This decision constituted a legal precedent, which had force of law if similar cases were brought before the court. There is in the British Museum a tablet on which a scribe has inscribed a certain number of such legal precedents; one, for instance, states that if a man make a contract in the name of another, such contract shall be void unless he has a power of attorney. Another states that if a man has promised to give his daughter in marriage, and has paid part of the dowry, he is bound by this act and cannot withdraw his word. Difficult cases appear to have required the light of the highest authorities in the bar. One tablet bears the seals of seven judges and two scribes. The tablets recording the most important cases involving new points were copied, very often at the request of lawyers, for if the decision recorded was brought as argument the tablet or its copy had to be produced. After every law suit the original tablet bearing the seals of the magistrates was kept by the scribe who had drawn it, but every party concerned received a copy. This explains how we possess several copies of the same document.

The criminal and civil cases were dealt with in much the same way, but in the former the accused was generally put under arrest, and kept in prison till his case came before the court, even when the accusation emanated from a private person. The prisoners so kept in suspicion were sometimes very badly used, especially when accused of political offences. We have the letter of a magistrate who complains in a petition to the king of having been accused by his enemies, and treated most harshly when in prison. Many cases which, among us, are considered as civil were by the Babylonians regarded as criminals, such as repudiation without cause, the refusal of a child to provide for his parents, etc. The criminal court was probably held in a public building in the centre of the town. The civil courts were held at the gates of the town.

Every magistrate was accompanied by his clerk, or witness, as he was called, who answered exactly to the French *greffier*. This special scribe read all the documents, and wrote the tablets giving the decisions of the judge. As already stated, everything appears to have been transacted in writing. The plaintiff or prosecutor had to give his statement in writing, then the defendant answered in writing; the witnesses, when called to the bar might have given their statements in words, but they were always taken down by the judge's clerk, and from this, perhaps, came his name of "Witness." Every statement or affidavit had to be accompanied by all the documents referred to therein, what is called in our legal parlance "exhibits." This last point was essential. A tablet, now in the British Museum, records the case of a slave who claimed the rights of a citizen on the ground of his having been freed by his late master, but not being able to produce the tablet containing the deed of freedom, the judge declared that he could not grant his request, and that he was to remain a slave.

In civil cases the penalties were limited to fines and compensation to the injured party, the condemned was seldom sent to prison, and even this was done only in the event of his refusing, or of his inability, to pay the fine and compensation inflicted on him; for the death of a slave also—for slaves were ranked as properties—money was received for compensation. Capital punishment—mere decapitation by the means of a sword—torture, mutilation, exile and imprisonment were reserved for criminal offences, and judging from the very few number of cases which have come under our notice, the application of such penalties was of rare occurrence. The Babylonians, like the Ninevites, appear to have inflicted the most cruel forms of punishment on their political enemies.

When a criminal had been condemned he was placed in a cart and driven about the town, while a herald announced the cause of his condemnation. In some cases the criminal was even exhibited in the pillory in some public place. There is in the British Museum a small tablet which has been a puzzle to many scholars, for it contains only one sentence, apparently unfinished. This tablet merely gives the text which the herald had to read aloud: "For having killed her own child," and in connection with this custom can be easily understood.

There was no court of appeal among the Babylonians; when the prisoner was condemned his fate was generally sealed. He had, however, one resource—the right of petition to the King. The kings, as a rule, were most conscientious, and took into consideration every letter addressed to them; if a judgment was evidently unjust, there was every reason to believe that it would be reversed.

The Akkadian treatises spoken of above were considered as the base of the Babylonian law, but the laws, as amended, modified, and explained by new edicts of the kings, orders of the chief civil officers of the state, and the legal precedents, were never codified officially; if private works existed on the matter, as is likely, none have come down to us. The consequence is that to get an accurate notion of the Babylonian laws, the student has to go through an innumerable number of tablets taking note of every special case and classifying them, just as the compiler of our English laws has to do if he wishes to produce a book of references, but with this disadvantage, that many important Babylonian documents may be lost, or still buried in Mesopotamia. The labour through which we have to go may give us an idea of the important part played by the legal scribe in every law suit in Babylon.

Another point deserves a special mention, that is the influence exercised by the Babylonian laws and customs on those of other nations. The Babylonian influence on Greek art, literature, religion, and philosophy has recently been recognised, but the laws and customs are no exception. If the Greeks borrowed from Mesopotamia the custom of burning the dead, they must have adopted others also. In fact, when going through these legal tablets one cannot help being struck by the existence of laws and customs which have been continued by the Greeks and Romans. If our lawyers study the Justinian Code, why should they despise and neglect the Babylonian laws? These have, historically, perhaps even a greater importance.

What are Microaerolites?—We are fully convinced of the occurrence of the shooting stars which occasionally traverse the heavens and of the meteoric stones of different sizes which sometimes fall from the depths of space. But it is not so decided whether or not the earth receives true showers of cosmic dust. M. Démoulin has collected and examined the inorganic dust brought down by the rain at Grignon in the Côte d'Or, in France. He calls these dust grains, *microaerolites*. They seem to belong to three distinct types. One kind is globular, very black and highly magnetic, closely resembling ferruginous globules obtained by incandescence. Those of the second type are of a sponge-like structure, resembling minute corals. These also are very magnetic. The third type are small stony masses of variable colour. Among them may be distinguished small black granules which are in general but slightly magnetic.

POISONS AND POISONING.

A Lecture delivered by C. Meymott Tidy, Esq., M.B., etc., before the Royal Institution of Great Britain.

TOXICOLOGY is the science of "poisons and poisoning." How comes "toxicology" to mean "the science of poisons?" The Greek word τόξον (derived perhaps from τυγχάνω) signified primarily that specially Oriental weapon which we call "a bow." In the very earliest authors, however, it included within its meaning "the arrow shot from the bow."

In the first century, A.D., in the reign of Nero (a poisoner and a cremationist), Dioscorides, a Greek writer on Materia Medica, uses the expression τὸ τοξικόν to signify "the poison *for smearing arrows with.*" Thus, by giving an enlarged sense to the word—for words ever strive to keep pace, if possible, with a scientific progress —we get our modern and significant expression "Toxicology," the science of poisons and poisoning.

And there, in that little piece of philology (τόξον and τοξικόν—a bow and a poison), you have not only the derivation of the word, but the early history of my subject.

A certain grim historical interest gathers around the story of poisons and poisoning. It is a history worth studying, for poisons have played their part in history. The "subtil serpent" taught men the power of a poisoned fang. History presents poison in its *first* aspect in a far less repulsive form than it has assumed in latter days—for a world may grow wiser and wickeder withal. Poison was in the first instance a simple instrument of "open warfare." For this purpose our savage ancestors tipped their arrows with poison, in order that they might inflict certain death on a hostile foe. It can scarcely be questioned that the poison of the snake was the first material employed for this object. The use of vegetable extracts (such as *curarine*, the active principle of which is strychnine, and is employed at the present time by certain uncivilised communities) belongs to a later period.

And so the first use of poison was for an "open fight." It was reserved for later times to mix the cup of kinship with a treacherous, diabolical venom!

"An open fight!" Is the suggestion (think you) too wild, supposing "war chemists," with their powders, their gun-cotton, and their explosives never to have been invented, that nations would have turned for their "*instrumenta belli*" to toxicologists and their poisons. I claim, however (notwithstanding that in this we missed our chance), no more for my subject than its due, if I attempt to localise the very cradle-room of science as the laboratory of the toxicological worker.

Besides snake-poison, the use of animal fluids, either alone or mixed with snake-poison, with which to charge arrows, is pre-historic. Thus in old Greek legend we read how Hercules dipped his arrows in the gall of the Lernœan hydra to render the wounds they inflicted incurable and mortal, and how at last Hercules himself was poisoned by his wife's present, the tunic of the Centaur Nessus stained with his poisonous blood, which she vainly hoped might restore her husband's affection, but which only procured for him the frightful agonies and tortures of which he died.

The use of putrid blood as a poisonous agent, and the admixture of the snake-poison with blood, constitutes a curious history, when regarded in connection with our present views on septicæmia. The toxic activity of putrid animal fluids seems to have been recognised in very early times. And I suppose these early observations on the effects of putrid blood explain the view almost universally adopted, that blood itself was a poison. Thus the deaths of Psammenitus, King of Egypt (as recorded by Herodotus), and of Themistocles (as recorded by Plutarch), were said to have been effected by the administration of bullock's blood. Even Blumenbach, so lately as the middle of the last century, persuaded one of his class (by way of settling the question) to drink seven ounces of warm bullock's blood. The young man (good as were his intentions) did not die a martyr to science.

The history of poisons and poisoning, the contents of the first chapter of which I have thus briefly indicated (viz., the toxicity of the snake-poison and of blood), down to the final chapter, which commences with the properties and reactions of arsenic, forms a tempting subject for my lecture to-night. The histories of Circe and Medea—of Livia Drusilla and Locusta—of Tiberius and Nero—of the Borgias—of Hieronyma Spara, Tofana, Catherine de Medicis, St. Croix, and a host of other worthies, have proved charming topics for the marvel-monger. And it would not have been an unworthy subject to bare the truths underlying the stories of generations of story-tellers, obscured as they have become by the demand of ignorant sensationalism and the terrors of a mean superstition. But this is not the subject I have proposed to myself for the discourse to-night.

"What is a Poison?"

Two difficulties present themselves in answering this question:—

1. *The law has not defined a poison, notwithstanding that the law at times demands of science the definition of a poison.*

I know a case, for example, where a prisoner, indicted for the administration of a poison, escaped because the scientific witness declined to say that the drug administered by the prisoner was a poison.

2. *The popular definition of a poison is far from being a sound, much less a scientific definition.* Generally speaking, it comes to this, that "A poison is a drug that kills rapidly when administered in a small quantity."

The phrase "a small quantity" as regards weight, and the word "rapidly" as regards time, are as indefinite as the classical piece of chalk as regards size.

I define a poison as—

"Any substance which otherwise than by the agency of heat or electricity is capable of destroying life either by chemical action on the tissues of the living body, or by physiological action after absorption into the living system."

(A) It will be convenient to consider first, *What a poison is not.*

It is not an agent that destroys life by physical influences, such as heat and electricity.

It is not an agent that destroys life by any purely mechanical act (*e.g.*, pins are not poison, although fairly included in the phrase "destructive things").

It is not an agent that destroys life by the mere blocking out of that which is necessary to maintain life (*i.e.*, the action of a substance to be a poison must be more than mechanical).

This latter point requires further consideration:—

Both nitrogen and carbonic acid destroy life as certainly as they extinguish a burning taper. Yet nitrogen is not a poison, whilst carbonic acid is.

Nitrogen simply destroys life by blocking out oxygen. Given the presence of 20 per cent. of oxygen, the 80 per cent. of nitrogen possesses no toxic effect.

The carbonic acid, on the contrary, is specifically toxic. The admixture of 20 per cent. or of 80 per cent. of oxygen does not materially alter the case. Oxygen or no oxygen, CO_2 is a poison.

(B) Consider next, *What a poison is.*

It is an agent capable of destroying life.

The use of the phrase *deadly* poison is surplusage. If a body be a poison, it is deadly; if it be not deadly, it is not a poison.

My definition limits the mechanism whereby the toxic effect is induced, to *chemical* and *physiological* actions. I am conscious that this definition suggests classification. Certain it is, that Nature hates classification as truly as she declines definitions.

Let us trace some of these mechanisms of toxic activity. I select three illustrations of poisons belonging to different classes.

(1) *Sulphuric Acid.*—If a person swallows *sulphuric acid*, the tissues with which the acid comes into contact are more or less charred—"more or less," that is, according to the strength of the acid and the time of contact.

Charred.—This implies a chemical act, dependent on the power of sulphuric acid to combine with water.

The portion of the body thus charred dies. We call this *molecular* death. (This does not imply that *the person* is dead. Health is disturbed. Health is derived from the old Saxon word "Wholth," signifying *entirety.* Health implies the perfect rhythmicity of the bodily functions. It is that condition expressed with charming simplicity by Suffolk folk, who describe being "quite well" by the phrase "*they feel all over alike.*" The charring process [molecular death] has disturbed rhythmicity.) Before long all the members suffer with the charred stomach. The death, localised in the first instance, becomes general, the death of the entire body, *i.e.*, of the person, eventually taking place. We call that *somatic* death. This is poisoning by sulphuric acid. But the primary act of disturbance—the first interference with the rhythmicity of health—resulted from the chemical power of sulphuric acid to combine with water. It will be evident that the chemical action of a poison depends on the chemical relationships of that poison.

(2) *Carbonic Oxide.*—Carbonic oxide is a true poison. It is a gas that may often be seen burning with a blue flame on the top of a bright fire in the open fire-stove.

Its importance amongst poisonous bodies depends on the circumstance that it is evolved in many manufacturing operations (*e.g.*, lime and brick kilns, iron blast furnaces, copper-refining furnaces, etc.), and that it is always present in small quantity in coal-gas, constituting its true toxic constituent.

What, then, is the mechanism whereby carbonic oxide destroys life? The active agent of the blood is its red colouring matter (*Hæmoglobin*). To the chemist this substance abounds in wonder.

We have reason to believe that hæmoglobin is formed from the albumenoids, the synthesis of which albumenoids is limited to the vegetable. Essential as the albumenoids are to animal life, the animal is dependent for their formation on the synthetical processes taking place in the plant laboratory. The animal, however, can transmute one albumenoid into another (*e.g.* he can change albumen into a peptone), whilst he can also form from them bodies of less complicated constitution (*e.g.*, fat)—in other words, he can lower them in the scale. But, save with one exception, he cannot use them to effect higher synthetical formations. This single exception is hæmoglobin.

It is no matter for surprise that a body like hæmoglobin—one of the chief actors, so to speak, in the curious drama of life and living, which comes on the scene through a stage opening of which we neither know construction nor whereabouts—should possess unique chemical properties and relationships. I shall only trouble you this evening with one of these relationships.

As a general rule a substance that combines with oxygen with difficulty parts from it with ease, and *vice versa.* It is difficult to make gold combine with oxygen, but it is easy to decompose oxide of gold. Potassium easily combines with oxygen, but it required the genius of a Davy and the resources of the Royal Institution to separate potassium and oxygen.

In hæmoglobin, however, we have a substance that combines with, and delivers up, its oxygen (*i.e.*, is oxidised and reduced) with almost equal facility under similar conditions. Upon this and other chemical characteristics of hæmoglobin—as the oxygen-receiver, the oxygen-carrier, the oxygen-deliverer, the carbonic-acid receiver, carrier, and deliverer—the act of living depends. In other words, life depends on *the integrity* of the hæmoglobin—on the rhythmicity of those chemical processes in affecting which hæmoglobin is the primary worker.

With these facts before us, let us turn to the toxic action of carbonic oxide.

The hæmoglobin at once seizes upon and combines with the carbonic oxide, carbonic-oxide-hæmoglobin being formed.

Two difficulties arise:

1. The hæmoglobin, saturated with carbonic oxide, cannot combine with oxygen. Regarding hæmoglobin as a *common carrier*, the carriage is full.

2. The hæmoglobin, being saturated with carbonic oxide, cannot get rid of the carbonic oxide under the ordinary conditions of respiration and circulation. Again, regarding the hæmoglobin as a common carrier, the vehicle, full up, cannot be unloaded.

To put all this in scientific phraseology, carbonic-oxide-hæmoglobin is a comparatively stable compound, being neither decomposed by the presence of an excess of oxygen (as in the lungs) nor by carbonic acid. What must happen? The man dies because the integrity of the hæmoglobin has been disturbed—because the normal sequence of its oxidation and reduction has been interrupted by the formation of carbonic oxide hæmoglobin.

We call the result of all these chemical actions and interferences, poisoning by carbonic oxide.

3. *Strychnine* (the poison derived from St. Ignatius' Bean).

How does strychnine act? We know sadly little about it—so little that we use the phrase "physiological action" to express our want of knowledge. But we know something.

A marked chemical characteristic of strychnine is its power to combine with oxygen when the oxygen is presented to it in a nascent form.

Note then the conditions. Strychnine is in the body. There is also present in the blood hæmoglobin loosely combined with oxygen, which oxygen the hæmoglobin is always ready to give up on first demand. We are able to trace this action, and to see that the period of the primary strychnine fit coincides with the reduction of the hæmoglobin.

Why (you ask) does that kill? I cannot tell you. It is the highest form of knowledge to see the limits of positive knowledge, and to make that the starting-point for fresh inquiry.

From what I have said, it will be evident that my object has been to trace toxic energy to the chemical action of poisons on living tissues or fluids. The phrase "physiological action" must not be understood as implying any theory *re modus operandi.* There is a danger lest the phrase "physiological action" should be employed, or regarded, as explanatory. It no more explains (be it remembered) the action of certain drugs on the living body than the word catalysis explains fermentation.

(*To be continued.*)

CORRESPONDENCE.

The Editor does not hold himself responsible for opinions expressed by his correspondents, nor can he take notice of anonymous communications. All letters must be accompanied by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

EFFECT OF THE VENOM OF THE RATTLESNAKE ON ITSELF.

On page 612 of your paper it is said that "the venom of a viper or a cobra is entirely without effect when introduced into its own system or into that of another of its kind." This rule does not hold good with all snakes. A rattlesnake in the possession of Dr. Dearing is stated by Dr. W. J. Burnett, of the Boston Society of Natural History, to have "accidentally struck one of its fangs into its own body, when it soon rolled over and died." E. P. P.

THE NEW RINGS OF SATURN.

Your journal of June 29th contains an interesting description of the alleged discovery, by Dom Lamey, of several new rings exterior to those already known to gird the planet Saturn. The announcement of these new features will come as a genuine surprise to all those numerous observers who have never discerned a vestige of them, though habitually studying this interesting planet during a long series of years. I have myself obtained many hundreds of careful observations of Saturn, during the last quarter of a century, but never noticed anything of the rings supposed to have been seen by Dom Lamey. My own negative results, combined with the similar experience of hosts of other observers, lead me to the confident assumption that the new rings have no objective existence. They are either imaginative or illusory instrumental phenomena, and it is desirable, for the sake of scientific truth and the necessity of avoiding the dissemination of error, that the presumptive discoverer should critically test his instruments and his vision, and endeavour to trace out the cause of his abnormal seeings. He may depend upon it that he has been misled by non-attention to some simple source of illusion, and that the new rings have no foundation in fact. They are probably false appearances; the images of the true rings are perhaps reproduced by the bad adjustment of the lenses of the telescopes employed.

I think we may safely regard these supposed new rings of Saturn as in the same category as the satellite of Venus, the planet Vulcan, the rings of Neptune, and other chimerical discoveries which are more fanciful than real.

A Member of the Liverpool Astronomical Society.

ANSWERS TO CORRESPONDENTS.

C. W. L.—Kindly send your address. See notice at the head of this column.

RECENT INVENTIONS.

The following list has been compiled especially for the Scientific News *by Messrs.* W. P. Thompson *and* Boult, *Patent Agents, of* 323, *High Holborn, London, W.C.; Newcastle Chambers, Angel Row, Nottingham; Ducie Buildings, Bank Street, Manchester; and* 6, *Lord Street, Liverpool.*

Removal of Old Varnish.—A Mr. Myer has just patented in Germany a composition for removing old varnish from objects. It is obtained by mixing five parts of 36 per cent. silicate of potash, one of 40 per cent. soda lye, and one of sal ammoniac (hydrochlorate of ammonia).

Music.—Mr. J. Sample has patented means for turning over leaves of music. The invention consists of a tassel attached in rotation to the edges of the leaves of music, so that the tassel on the first leaf is at the bottom, the tassel on the second an inch higher, and so on to the end. The tassels or fringe may be fastened to the leaves by gum or other fastener.

Steam Generators.—Mr. J. Smith and D. Cowan have patented a steam generator. The invention consists essentially in the combination and arrangement of tubes and flues whereby a double return of the flame and heated gases from the furnace is obtained, and the area acted upon by them considerably increased. A thorough absorption of all the gases before they reach the chimney is ensured, and thus a great saving of fuel is obtained.

Electric-energy.—Mr. J. Ross has patented means for the production of electric-energy for lighting purposes. According to the invention, two commutators are mounted on the same spindle, which is driven at a high speed by a small motor. These commutators are each placed in circuit with a dynamo electric machine. They are also each placed in circuit with the inner and outer wires respectively of an induction coil, through which alternating currents of electric-energy are made to pass. The electric-energy produced may be employed for lighting lamps or other purposes.

Targets.—Mr. W. E. Heath has patented a miniature target for rifle practice at short ranges. The target is constructed as follows:—An iron shield, with wings to prevent splashing, is provided, having in its upper portion an opening through which the target is shown representing the proportion of a target as seen from the firing point on the actual range. The bull's-eye is in all cases at about the same height. Behind the screen is placed an iron plate, forming the segment of a circle, to which are attached all the targets required in their varying sizes. This plate revolves on a centre, so that any target can be shown at the opening by revolving; provision is also made for marking.

Speaking Tube.—A speaking tube has been patented by Mr. S. Gratrix, Manchester. This invention is to avoid the necessity of speaking and hearing at the same mouthpiece. The metallic coupling to which the tube and mouthpiece are attached is provided with another opening at the side which is covered by a revolving disc, to which is connected one end of an elastic tube, having an ear-piece at the other end. The revolving plate is so constructed that when the tube is allowed to remain in its normal position it closes the side opening so that there is no communication between the speaking tube and the ear-tube, but when the latter is raised to place it to the ear it opens the communication with the speaking tube.

LIFE-SAVING JACKET.—Mr. S. y. Valdivielso has patented a life-saving jacket. This garment is formed of waterproof material in the shape of a jacket having a hood which covers the head with the exception of the mouth, nose, eyes, and ears. The jacket, hood, and sleeves are all made of double cloth hermetically joined, so that when inflated by means of tubes it forms an air bag all round the body, the jacket being attached to the waist by a belt and metal rings. The front of the garment has four waterproof receptacles to carry water, meat, a lamp, and a trumpet. The back has a waterproof receptacle for containing documents, jewellery, etc. When not in use this garment is used as a handbag, but when in use it will sustain the wearer in the water, leaving his hands and all body movements free.

SIGNALLING.—Mr. P. R. Derriman has patented a visible signalling code. According to this invention, four signal lamps or flags are employed, these being arranged so as to be raised and lowered in rapid succession, and thus be visible and invisible at the distant station. The system is arranged so that the four signals being used in succession in various preconcerted orders, will indicate the letters of the alphabet, not more than three signals being required for any one letter. Of these groups of signals representing the alphabet, about one hundred sets are set out in a key book in four sections of twenty-five each, and to each is affixed, in the key book, a number whereby the same may be referred to a code of such phrases and signals as are most commonly required for use. These code numbers are capable of being increased to several thousand if desired.

GUNS.—Mr. W. Anderson has patented an apparatus for loading guns. The apparatus is as follows. The barrow, carrying the shot, has upon it two standards, at the upper end of which are recesses in which are carried the trunnions of a tray, in which the shot is laid. The shot is held steady in the tray by a movable stop upon the handle, which is removed before the shot is elevated to the gun. This elevating apparatus consists of a curved rack held between guide rollers, so that a circular movement can be imparted to it by a pinion which gears with the rack teeth. The curved rack has at its rear end an outer cradle, which receives the shot to be elevated, and also the tray in which the shot is carried upon the barrow. As the barrow comes to its place against the lifting apparatus, the trunnions on the inner tray pass up inclines upon the sides of the outer tray and drop into recesses; then the curved rack being put in movement the shot and trays are carried up in a circular course to the position required. When on the barrow, the shot is carried with its point inclined upwards at a considerable angle, but as in elevating the movement is over a curved course, the axis of the projectile becomes nearly horizontal, and it is then properly aligned to enter the gun.

TECHNICAL EDUCATION NOTES.

NATIONAL ASSOCIATION FOR THE PROMOTION OF TECHNICAL EDUCATION.—On Saturday afternoon the second annual meeting of this Association was held at the rooms of the Society of Arts, John Street, Adelphi. Lord Hartington, who presided, in his opening address referred to the Bills dealing with technical education in the House of Commons. The Bill of last year had been supported generally by the Association as being a step in the right direction, although they had desired to press on the Government and on the House several important amendments. The Bill of the present session, while it would, he believed, remove some of the objections which they had had to the measure of last year, contained proposals which he feared would revive some of the old controversies on the subject of education generally, and especially upon the religious question and the question of denominational and voluntary schools, which he feared would endanger the passing of any measure this session, and would be prejudicial to the cause of technical education. He trusted, however, that the effect of the discussion which had taken place might be to secure the passing of some measure without much further delay. The Committee of the Association still felt that there was a wide field open to the exertions of the Society by the establishment of branches in all the commercial centres by the circulation of information, and especially by the promotion of discussion as to the scope and character of the technical education which required to be provided. There were very few open opponents to the extension of technical education. There were very few who actually disparaged or denied its necessity, but still they were very far from having obtained a proper recognition of its necessity and importance. If we could rely on the old agencies and the old methods to secure that supremacy in later times they might rest in peace, but if they were threatened by a new and a formidable competition in all parts of the world, then, if other nations have discovered by means of a better system of technical education how to make the labour of their populations more valuable, and if they had discovered methods of competing with ourselves, which were better than our own, then he thought the Association, by calling public attention to it, and by endeavouring to point out the way in which we could retrieve, if we had lost, our commercial prosperity, was one which was doing a good work, and one which deserved the support of the country.

ANNOUNCEMENTS.

AWARD TO PROFESSOR VIRCHOW.—The Scientific Society has adjudged the Boerhaave gold medal for anthropology to Professor Virchow.

BRISTOL AND GLOUCESTERSHIRE ARCHÆOLOGICAL SOCIETY.—This Society will hold its thirteenth annual meeting at Gloucester on the 16th, 17th, 18th, and 19th of this month. The opening meeting will be held on Monday morning; in the afternoon the cathedral will be visited, and in the evening papers will be read on "The Annalia Dubrensia," by Mr. F. A. Hyett; "The Masons' Square and Masons' Marks," by Mr. H. Jeffs; and on "St. Oswald's Priory," by Mr. H. Medland. On Tuesday Mr. J. Bellows will deliver an address on "Roman Gloucester," and the Rev. W. Bazeley an address on "Mediæval Gloucester." Parties will be organised to visit the Roman remains, and the churches, priories, and other mediæval remains. An expedition will also be made to Llanthony Priory and Hempstead Church. In the evening the following papers will probably be read:—"The Hospitals of St. Margaret and St. Mary Magdalene," by the Rev. S. E. Bartleet, M.A.; on "The Grey Friars, Gloucester," by Rev. W. H. Silvester Davies, M.A.; on "Scrivens' Conduit," by Mr. H. Medland; and on "Gloucester Tokens of the 17th Century," by Mr. J. P. Wilton. On Wednesday an excursion will be made to Brockthorpe, Haresfield, Standish, Hardwicke, and Elmore. In the evening there will be a *conversazione* in the temporary museum. On Thursday the final meeting will be held, and an excursion will be made to Churchdown, Badgeworth, and Prinkwash.

SALES.

The Charge for Advertisements in this Column is Sixpence for the first sixteen words, and Sixpence for every succeeding eight words. Advertisements for this Column should be received by first post on Tuesday to insure insertion in the following number.

EXCHANGES.

Exchange Notices will be inserted in this Column at the rate of Sixpence for the first twenty-four words, and Threepence for every succeeding eight words. Advertisements for this Column should be received by first post on Tuesday to insure insertion in the following number.

SELECTED BOOKS.

Outlines of Geology. By James Geikie, L.L.D., F.R.S. An introduction to the Science for Junior Students and General Readers. With 400 illustrations. London: Edward Stanford. Price 12s.

Three Cruises of the "Blake." By Alexander Agassiz, Director of the Museum of Comparative Zoology at Cambridge, Mass. Fully illustrated. London: Sampson Low, Marston, and Co. In 2 vols., 8vo. Price 42s.

Nature's Hygiene. A Systematic Manual of Natural Hygiene. By C. T. Kingzett, T.I.C., F.C.S., Ex-Vice-President of the Society of Public Analysts. Third edition. London: Bailliere, Tindall, and Co. Price 7s. 6d.

The Physical Culture of Women: Lecture delivered at the Parkes Museum of Hygiene, March 16th, and at the Society of Arts, April 25th, 1888. By Miss Chreiman. Published by request. London: Sampson Low, Marston, and Co. Price 1s.

Forms of Animal Life. A manual of Comparative Anatomy, with Descriptions of Selected Types. By the late George Rolleston, D.M., F.R.S. Revised and enlarged by W. Hatchett Jackson, M.A. Second Edition. London, Clarendon Press. Price 36s.

A Text-Book on Steam and Steam Engines. For the Use of Students Preparing for Competitive Examinations, By A. Jamieson, C.E., F.R.S.E. Prof. of Engineering. Glasgow Technical College. With 200 illustrations and four folding Plates. Third edition. London, Charles Griffin and Co. Price 7s. 6d.

A Manual of the Mollusca. A Treatise on Recent and Fossil Shells. By Dr. S. P. Woodward, A.L.S. With Appendix by Ralph Tate, A.L.S., F.G.S. With numerous Plates and 300 Woodcuts. Fourth edition. London: Crosby, Lockwood and Sons. Price 7s. 6d.

Electro-Plating: a Practical Handbook on the Deposition of Copper, Silver, Nickel, Gold, Aluminium, Brass, Platinum, etc., with Descriptions of the Chemicals, Materials, Batteries, and Dynamo Machines used in the Art. By J. W. Urquhart, C.E. London: Crosby, Lockwood and Co. Price 5s.

An Atlas of Anatomy; or, Pictures of the Human Body. In 24 large Coloured Plates, comprising 100 separate figures, with descriptive letterpress. By Mrs. Fenwick Miller, late Member of the London School Board. Third edition. London: E. Stanford. Price 12s. 6d.

The Laboratory Guide. A Manual of Practical Chemistry for Colleges and Schools. Specially arranged for Agricultural Students. By A. H. Church, M.A., F.R.S., Professor of Chemistry in the Royal Academy of Arts. London: Gurney and Jackson, 1, Paternoster Row. Price 6s. 6d.

METEOROLOGICAL RETURNS

For the ten weeks ending on Monday, July 2nd, 1888. Specially prepared for SCIENTIFIC NEWS from official reports.

	Mean Temperature.	Rainfall.	Duration of Sunshine.
Scotland, East	48·9 degs., being 1·9 degs. below average.	5·6 ins., being 0·5 ins. above average.	472 hrs., being 37 hrs. above average.
England, N.E.	49·7 „ „ 2·7 „ „ „	3·6 „ „ 1·0 „ below „	368 „ „ 49 „ below „
England, East	52·4 „ „ 2·3 „ „ „	3·9 „ „ 0·6 „ „ „	399 „ „ 88 „ „ „
Midlands ...	52·1 „ „ 2·2 „ „ „	4·8 „ „ 0·2 „ „ „	377 „ „ 52 „ „ „
England, South	52·5 „ „ 1·9 „ „ „	4·7 „ „ 0·4 „ above „	402 „ „ 50 „ „ „
Scotland, West	50·8 „ „ 0·7 „ „ „	9·6 „ „ 3·0 „ „ „	458 „ „ 31 „ above „
England, N.W.	51·5 „ „ 2·3 „ „ „	5·3 „ „ 0·8 „ below „	395 „ „ 47 „ below „
England, S.W.	52·5 „ „ 2·1 „ „ „	6·1 „ „ 0·0 „ average	438 „ „ 50 „ „ „
Ireland, North	51·2 „ „ 1·9 „ „ „	8·5 „ „ 2·8 „ above „	426 „ „ 36 „ above „
Ireland, South	53·2 „ „ 0·9 „ „ „	9·1 „ „ 3·2 „ „ „	427 „ „ 5 „ „ „
The Kingdom...	51·5 „ „ 1·9 „ „ „	6·1 „ „ 0·7 „ „ „	416 „ „ 23 „ below „

Scientific News

FOR GENERAL READERS.

FRIDAY, JULY 20th, 1888.

CONTENTS.

SCIENTIFIC TABLE TALK.

By W. Mattieu Williams, F.R.A.S., F.C.S.

In my last I said something that may have puzzled some of my readers, viz., that the indestructibility of matter is virtually the same as the conservation or indestructibility of energy.

The following passage by an eminent writer, who has ably elucidated the subject of the conservation of energy, shows plainly enough that an explanation of my apparent heresy is demanded.

Balfour Stewart says (*Nature*, vol. ii., p. 78) that "the chemist has always taught us to regard quantity or mass of matter as unchangeable, so that, amid the many bewildering transformations of form and quality which take place in the chemical world, we can always consult our balance with a certainty that *it* will not play us false." But now the physical philosopher steps in and tells us that energy is quite as unchangeable as mass, and that the conservation of both is equally complete. There is, however, this difference between the two things—the same particle of matter will always retain the same mass, but it will not always retain the same energy."

Here is stated a broad distinction between mass and energy, although the mass is described as measured by gravitation. Mass is regarded as inherent, while energy is represented as something contingent, something supplied to matter from outside—something demanding, as Herbert Spencer says, an outside conservator to effect its conservation.

According to my view, the energy of matter is inherent, and what we call the *mass* of matter is simply a measure of its primary energy, *i.e.*, its gravitation. As Stewart says, the balance is always consistent, but what is a balance but an instrument for measuring the mass of matter in terms of its gravitating energy?

I regard that old scholastic word "*inertia*" as a most wicked word—philosophically speaking—as the source of an incalculable heap of offences against true philosophy. Matter is not inert; those who believe it to be so are scientific pagans, their paganism corresponds to that of the ancients and other savages. These people imagined an outside fetish, or spirit, or god, or demon to specially animate moving masses; there was Boreas, who set the winds a-going; there were river gods that made the river flow; there was Apollo, to give the sun a daily ride in his chariot; there was Vulcan or Thor thumping out earthquakes; there was Jupiter, with his handful of thunderbolts, transacting the business now made over to the electric fluid; and a multitude of other active movers of inert matter.

In continuation of the above-quoted passage, Stewart says, "As a whole, energy is invariable, but is always shifting about from particle to particle, and hence it is more difficult to grasp the conception of an invariability of energy than of an invariability of mass."

Energy is thus presented as an active, meddling spiritual entity—a demon or fairy always at work setting dead or inert matter in motion, and possessing that special attribute of the gods and demons and fairies, the power of assuming various forms, according to the tricks to be played or the work to be done.

Why not reject, at once and completely, all these superstitions, whether ancient or modern? Why not accept the unquestionable fact that matter is active—that all the energies or forces of the universe, so far as we know them, are simply the inherent activities or energies of matter itself? How it became endowed with such activity is a question I will not venture to approach.

We become acquainted with the existence of matter only by means of our senses—by its action upon our senses. I see an object when the object is actively engaged in emitting radiations towards my eyes. Otherwise I see it not. I smell an object if it is actively emitting odour. I taste those things which have certain chemical activities. I hear the movements of those bodies which actively transmit their tremblings to the air, and thence to my auditory apparatus. I feel those objects that resist my efforts to remove them, or that exert an energy of cohesion resisting my passage through them.

If a world as big as Jupiter, and absolutely inert, were now in front of me, touching my nose, I should be unconscious of its existence. If absolutely inert, it would have no energy of reaction wherewith to resist my slightest forward movement; I should pass through it or push it forward without sensible effort. I could not see it unless it were actively emitting light. It would not hide other objects unless its own energy were sufficient to overpower the energy of luminous radiation.

The idea of such a body is of course a paradox, but why? Simply because our natural and necessary idea of an existing thing involves fundamentally the idea of some inherent energies, *i.e.* properties, in such entity.

Long ago Torricelli said, "La materia altro non è che un vaso di Circe incantato, il quale serve per ricettacolo della forza"—"Matter is nothing more than an enchanted cup of Circe serving as the receptacle of force." He thus located force within matter itself, but I go further, and maintain that matter and force are inseparable—for aught we know, identical.

All matter is in motion or striving to move. The chair on which I sit is moving with the earth in its rotation and revolution and flight with the sun through space, and is at the same time striving to move towards the earth's centre, and would do it, but for the active resistance of the earth's cohesive energy.

If you strike a man, and he retaliates with equal force, you cannot describe him as inert. In like manner I regard Newton's axiom, that action and reaction are always equal and contrary, as a description of the universal pugnacious activity of every form of matter.

To further illustrate this, let us take an imaginary case. Let us suppose the earth to be perforated by a tubular tunnel, going through from any part of its surface to its centre of gravity and on to the antipodes. Let us suppose this tube to be a vacuum. What would happen if a ball of any material were dropped from one end of the tube in such position that it should not come in contact with the sides in the course of its falling through? It would descend with accelerated velocity until it reached the centre; the velocity there acquired would be just sufficient to throw it up to the antipodean surface on the other side of the earth. At the surface it would stop for an instant, then fall back, and go on again to its starting place. This reciprocating journey would continue eternally, and the whole motive force producing such perpetual motion being the inherent activity of the matter of the earth and that of the travelling ball, *i.e.*, their gravitating energies, the invariability and indestructibility of which is shown, as Stewart says, by "our balance with a certainty that it will not play us false."

In this case we have molar motion of enormous velocity, both created and arrested without any loss or increase of temperature whatever.

Before leaving this subject, I must correct a common error, viz., that of assuming that the doctrine of the conservation of energy is a modern innovation (see Balfour Stewart, *Nature*, vol. i., p. 647). Leibnitz, who was a contemporary of Newton, in a letter to Dr. S. Clarke, says: "*I have maintained the conservation of active forces in the world.* It was objected to this that two soft, non-elastic bodies, on meeting, lose some of their force. I answer no. It is true that the masses lose it, as to their entire movement, but their particles receive it, being internally agitated by the force of the meeting. Thus the loss is only in appearance. The forces are not lost, but only dissipated among the small particles. Now this is not to be lost, but to act as those do who change a piece of money into small coin."

No modern writer has enunciated the doctrine more concisely and clearly than this.

TENNYSON AS A NATURALIST.

TENNYSON is our English Theocritus. It would be bold to claim that he has excelled the Sicilian idyllist in charm or knowledge of his art, but it is not extravagant to thank him for giving to the grave thoughts of our reflective age that airy poetic touch with which Theocritus was able to brighten the trivial details of a simple country life. In Tennyson we have many qualities besides those that make the singer. Among the rest are learning and knowledge of Nature. Perhaps no English poet since Milton has read so widely and so profitably in the books of ancient verse; probably no poet in any past age has drawn so real an inspiration from birds, and flowers, and from the thoughts which occupy the scientific student. Sometimes Tennyson uses his knowledge of Nature as a store of graphic circumstance. Observation enables him to enrich his expression by telling epithets, without alteration or even expansion, of the thought thus decorated. When he bids the long-delaying new year

"Bring orchis, bring the foxglove spire,
The little speedwell's darling blue,
Deep tulips dashed with fiery dew,
Laburnums, dropping wells-of fire."
("In Memoriam," lxxxiii.)—

our memory gains some jewelled phrases, which, detached from all thought of sorrow for the dead, come back into our thoughts year by year, as the seasons bring the flowers of summer.

Sometimes the observation of the naturalist-poet is so penetrating as to fix our attention for all future years upon features in which no one before Tennyson saw anything worthy of remark.

"More black than ash-buds in the front of March"

is a line which stamps an emphasis never to be forgotten upon a sight which we used to pass by with listless indifference.

The stanza,

"When rosy plumelets tuft the larch,
And rarely pipes the mounted thrush,
Or underneath the barren bush
Flits by the sea-blue bird of March,"

sets the larch and the kingfisher of early spring in their corner of the canvas with the sprightliness and the sure touch of Rosa Bonheur.

Tennyson has other uses for these rapid glances into the underlying significance of Nature. Now and then the flash of unfamiliar analogy suggests a thought new to poetry. The lines,

"Wearing his wisdom lightly, like the fruit
Which in our winter woodlands looks a flower,"

are the very soul of that Dedication, which, but for the Spindle-tree, would have taken a quite different and less vivid turn.

The verses to J. S. reach their highest point when they bring in the long-lasting summer twilight of the northern shores, never turned to such poetic service before:

"His memory long will live alone
In all our hearts, as mournful light
That broods above the fallen sun,
And dwells in heaven half the night."

That Tennyson's use of natural fact depends upon real sympathy—that the sight has power in him to call up the thought—is clear to all who observe how the animals and flowers which throng his written fancies render each its due service. This is the test of reality and sincerity. Browning squeezes into his rhymes

"The bee with his comb,
The mouse at her dray"

(It should be the squirrel),

"The grub in its tomb,
Wile winter away;
But the fire-fly, and hedge-shrew, and lob-worm, I pray,
How fare they?"

The bee, and the grub, and the lob-worm do nothing for the poet at least. But what desolation is added to Aylmer's Field by the shy creatures which come back to their ancient haunts, after the wilful lord has undone the last of his race:

"The hedgehog underneath the plantain bores,
The rabbit fondles his own harmless face,
The slow-worm creeps, and the thin weasel there
Follows the mouse, and all is open field."

THE BLACKMAN AIR PROPELLER.—II.

IN our last number we described this very useful apparatus, and mentioned that, besides being suitable for ventilation, it is largely used in many industries for drying purposes. In the accompanying figures we illustrate some very successful applications of the propeller. Fig. 2 represents the rag-cutting room of a paper mill, where the dust is not only very inconvenient but injurious. By means of a propeller, which causes upward currents of air through gratings in the floor, in the direction ot the arrows, the dust is now completely removed from the cutting-room, and is all discharged into an adjoining settling room, where the bulk of it is collected.

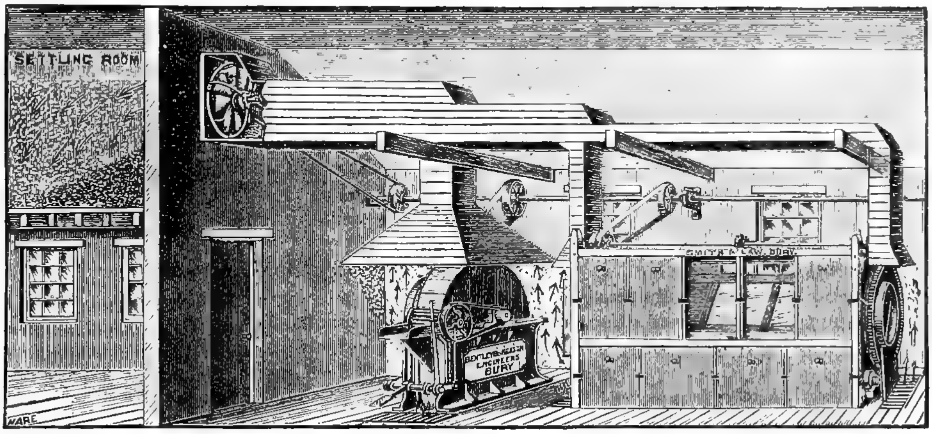


Fig. 2.—Air Propeller RemovingDust from a Rag-Cutting Room in a Paper Mill.

In Fig. 3 we give a longitudinal section of a steam laundry where one air propeller is used for three different purposes. It will be seen that the propeller is fixed between the drying room and the washing room. The air inlets are in the ironing room, and between the latter and the upper drying room, and again between the upper and lower drying rooms there are openings in which are placed coils of piping, heated by steam. The outlet is at the end of the washing room, farthest from the propeller. When the latter is in operation fresh air is drawn through the ironing room, which is agreeably

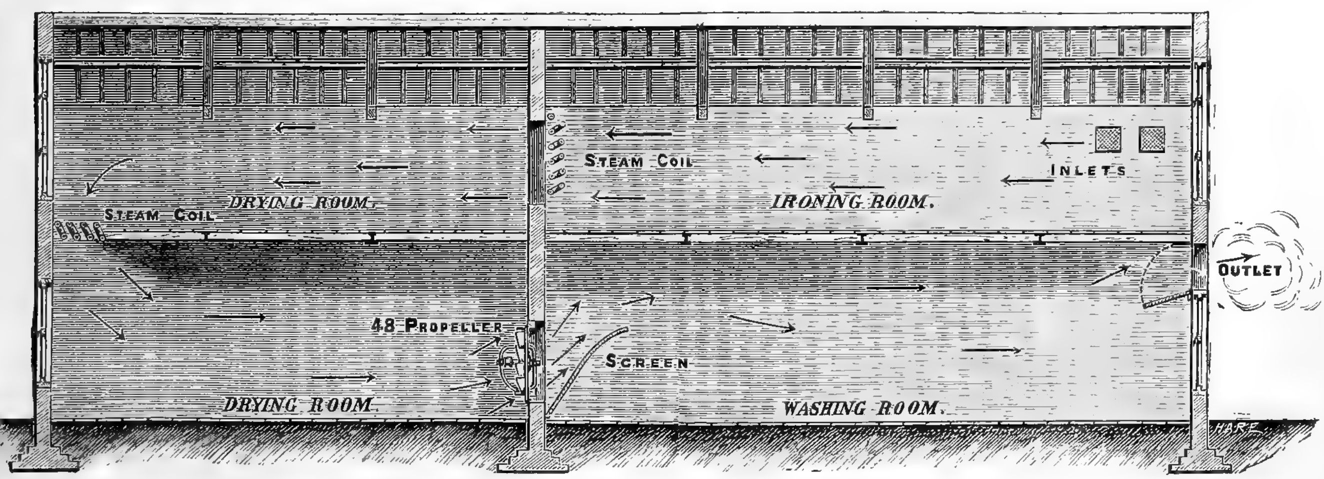


Fig. 3.—Air Propeller used for Cooling, Drying, and Ventilating in a Steam Laundry.

The Dog Nuisance in Paris.—Rabid dogs are said to be extremely prevalent at present in Paris, and the authorities are at last taking stringent measures. A medical contemporary remarks that the Pasteur Institute ought to be most abundantly supplied with cases for treatment.

cooled. The air then passes over the first steam coil, and is heated sufficiently for the upper drying room. After this it is again heated by the second steam coil, and is used for drying in the lower room. Finally it serves to remove the steam in the washing room. The whole contrivance is at once simple and effective, and is a great relief to the *employées*, who would otherwise have to do their work under the usual very unhealthy conditions.

BUDS.

(*Concluded from page* 34.)

It has been mentioned that lateral (not apical) buds arise in the axils of the leaves, which is known as *axillary* growth, and this mode of origin is characteristic of the buds of all flowering plants except the gymnosperms, or plant with naked seeds, such as the pines, which certainly produce their lateral buds in the axils of their leaves, but not in the axils of *every* leaf, as is usually the case with the other flowering plants. In the cryptogams, or so-called flowerless plants, lateral buds arise mostly near or below the leaf. But even in the flowering plants various deviations from the axillary mode occur, *e.g.*, two or three buds may be formed one above another (*Lonicera*), or the bud may advance along the stem so as to be above the axil, or the leaf may be formed late and advance upon the young shoot itself, appearing as its first leaf. In flower-buds also—to which many of the details concerning leaf-buds apply, flowers being composed of modified leaves—the *subtending* leaf or bract is frequently wanting. Still the system of axillary growth is pretty constant, and Warming looks upon the leaf and bud in flowering plants as a double organ, they being united at the base.

But this constancy of formation as buds is far from being accompanied by constancy of development into shoots, as many buds from want of sufficient nourishment do not sprout at all; some, indeed, being suppressed in a regular manner, giving a characteristic branching to the plant. This latter feature is well shown in certain members of the pink family (Caryophyllaceæ) where the leaves grow in pairs that cross each other, and only one axillary bud is developed, giving rise to a spiral arrangement. In certain plants (elm, hazel, and lilac) the bud at the end of each shoot is suppressed, the next below, which is lateral, continuing the growth. Terminal suppression tends to produce bushiness, whilst lateral suppression produces loftiness. The difference of form thus brought about may be well contrasted in the Lombardy poplar and the black poplar, the former being tall and slender through the suppression of its lateral buds, the latter short and spreading through the suppression of its terminal buds. The greatest suppression takes place in the Monocotyledons (plants with generally parallel-veined leaves), and is well seen in most palms, which produce their foliage-leaves in a cluster at the top of an unbranched stem. It frequently happens in plants, the buds of which are not suppressed upon a regular plan, but from want of nourishment, that these "dormant eyes" will sprout, an occurrence which generally takes place in consequence of the access of more light and air, or more often through some of the branches having been lopped off, as in pollards, leaving an excess of nourishment in the plant that stimulates the dormant organ to activity.

These "dormant eyes" must not be confounded with what are termined *adventitious* buds, the term *adventitious* being used in opposition to *normal*, which, when applied to buds, signifies that they are formed, as most buds are, *acropetally*, or from the base to the apex of the axis, no normal bud arising lower than one already existing, whilst buds are *adventitious* when they do so arise. They occur in many ways, and seem to be the result of an attempt on the part of the plant to get rid of excessive nourishment and vitality. On old cut stumps they appear upon the "callus," or cambium layer swollen up between the bark and the wood, and upon detached leaves and pieces of stem and root, especially when these are kept in darkness. But it is chiefly on the leaves that they are formed, as in the bulbils found in the angles of the branching of the veins of the cuckoo flower (*Cardamine pratensis*), and in the common water-cress (*Nasturtium officinale*), and most strikingly in the centre of the leaf of *Nymphœa micrantha* and in several of the Aroideæ, *e.g.*, *Atherurus ternatus*, as tubers or bulbs which separate and become independent plants. They are found on the foliage-leaves of many monocotyledons too, but remain in the bud condition so long as the mother-leaf continues vigorous. They are very common on the fronds of ferns (fig. 8) (*Ceratopteris thalictroides*, *Asplenium caudatum*, *Woodwardia radicans*, *etc.*), where, as in the cuckoo-flower, they become vigorous, many-branched shoots, which ultimately carry on an active individual growth free from the parent. The male fern (*Aspidium filix-mas*) produces no other lateral branches than those which proceed from adventitious buds situated on the basal parts of the backs of the older foliage-leaves. Not infrequently the roots of plants give origin to buds which develop into independent plants, the ordinary Acacia being a familiar example, whilst on certain of the roots given off, by the underground stem of the Bird's Nest Orchis (*Neottia nidus-avis*), a very rare mode occurs in which the root-cap is torn off and the growing-point of the root becomes a shoot. The origin of adventitious buds has been usually considered to be what is termed *endogenous*, that is to say, they arise from the internal layers of the tissue of the axis producing them, which on stems would be from under the bark or from its inner layers, whereas normal buds arise *exogenously*, or from the outer layers of the bark. But recent researches have thrown some doubt upon the theory of the endogenous origin of adventitious buds which Hoffmeister taught. Particularly pertinent are the experiments of Hanstein on the cuckoo-flower and the water-cress, in which he shows that in the epidermis, and subjacent tissue of fully-developed leaves, certain changes occur, which transform permanent tissue into embryonic, by which a conical growing-point is produced, from which arise roots and leaves. With regard to the adventitious buds formed on cut stumps, these must be endogenous, as they spring from the cambium layer, which is situated in the middle of the fibro-vasular tissue of a plant. Indeed, until very lately, it was thought that the normal buds of horsetails (*Equisetums*) were an exception, and arose endogenously; but it has been found that at the growing point their origin is exogenous, and they become enveloped by the tissue of the mother-shoot by subsequent changes. (Fig. 9.) Hansen has further shown that in *Gleditschia* the embryonic tissue near the axil persists for a long time becoming overgrown by the cortex of the current year's growth, and that upon sprouting in the following spring the bud appears to break through it, it being one of the ways in which growing points are protected for future growth.

The matter in general, however, requires further investigation.

Connected with this subject of adventitious buds is a number of facts which go to demonstrate what may be termed the independent vitality of buds. Gardeners have long made use of this property of adventitious budding as a means of propagation. *Anemone japonica*, for example, is generally propagated by cuttings of the root. The artificial production of adventitious buds on the scales of bulbs and on leaves and fragments of leaves of *Bryophyllum*, *Echeveria*, *Gloxinia*, etc., is generally effected by subjecting them to heat and moisture, as by laying them on moist earth or sand. For scientific experiments, it is better to suspend them in moist air to obtain an "equable environment." When pieces of stems are so suspended, roots arise from their bases and buds from their apexes, the reverse being the the case in pieces of root. But this power of independent growth is far from being confined to adventitious buds; in fact, it is a rule that every leaf-bud may be removed, and with proper treatment turned into a new plant—a fact that, both naturally and horticulturally, is of

FIG. 8.—(After Sachs.) *Asplenium decussatum*; central part of the mature leaf; its mid-rib *st* bears the pinnae *ll*; at the base of one of these is formed the bud, *k*, which has commenced to grow.

great importance. In Nature this occurs by axillary buds in *Lilium bulbiferum*, bulbiferous bitter-cress, or coralroot (*Dentaria bulbifera*), and in the inflorescences of flowers, as in species of *Allium*, and that interesting example, the viviparous polygonum (*Polygonum viviparum*), where either all the flowers or the lower ones are changed into little red bulbs. The "eyes" of the potato, also, may be separated and caused to produce an independent plant, as is also the case with the "cloves" or small bulbs formed in the axils of parent bulbs. Bulbs, it may be said, are analogous to buds, the great difference being that the fleshy leaves of the former act as reservoirs of plant-food, whereas those of the latter are, of course, the great centres of its manufacture. The operations of grafting, "budding," etc., depend upon this property of independent development, and in such operations one important precaution has to be taken, viz., the bringing of the cambium regions (layers of embryonic tissue running through the plant which maintain and renew their annual growth) of both "scion" and "stock" into contact. As an illustration, the following account of the operation of "budding," abstracted from Beeton's "Garden Management," may not be out of place :—"The bud is cut from the parent plant with about $\frac{1}{4}$ in. of bark attached above and below, forming what is called a 'shield,' and from this the wood must be removed without injuring the inner bark. The buds or 'eyes' in the axils should be well developed, or they must be made so by pinching the growing point and causing a reflux of sap to the base, and in twelve days the axillary buds will be sufficiently developed, the bud then being separated. Should any leaves be expanded they must be detached, the stalks being left. A T-shaped cleft is then cut in the 'stock,' which should be from one to five years old, and in full growth (May to September), allowing of ready removal of the outer bark from the 'liber' or inner bark. The bark of the bud is then inserted under the bark of the 'stock,' and the whole is then bandaged up, contact between the liber of

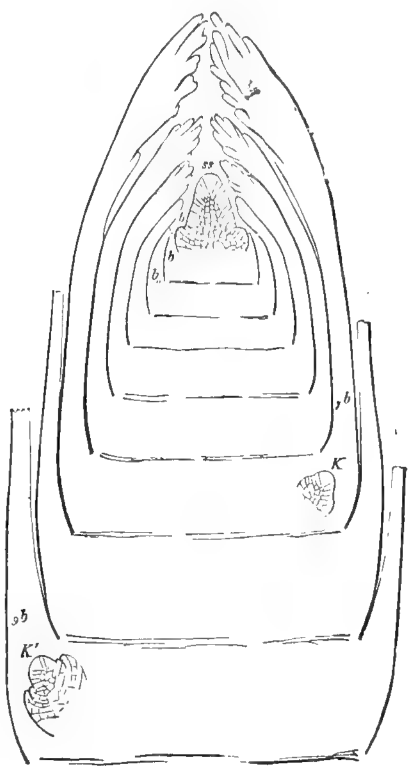


FIG. 9.—(After Sachs.) *Equisetum arvense*; longitudinal section through an underground bud in March; *ss*, the apical cells of the stem; *b*-9*b*, its leaves; *KK'* two endogenous lateral buds exposed by the section × 50.

both being ensured. The head of the 'stock' is then cut down in order to reserve an ample supply of nourishment for the 'scion,' which rapidly shows vigorous growth. Grafts may be made on roots in the same way, which, when separated with the bud in the following spring, forms new individuals."

Among the many interesting facts connected with the physiology of buds, those connected with *respiration* and the circumstances which determine the time of sprouting may be mentioned here. With regard to respiration, Garreau is responsible for the following particulars :—"12 buds of the lilac, weighing 2 grams (about 1-16th of troy oz.), at 112° Fahr. exhaled 70 c.cm. (about $4\frac{1}{2}$ cubic inches) of carbonic acid gas in 24 hours, the leaves having expanded. Five buds of *Æsculus macrostachya*, a kind of horse-chestnut, weighing 85 grams (about 2½ troy ozs.), gave off 45 c.cm. (about 3 cubic inches) of carbonic gas in 24 hours, the leaves having expanded." And in regard to bursting flower-buds, it has been noted that an orobanche in full bloom used up its own volume of oxygen in 36 hours, or 4·2 c.cm. per grain of substance, corresponding to a loss of 2·26 milligrams of carbon. All this chemical action is concerned in the production of energy required to do the work of expansion, and is accompanied by the production of heat that becomes particularly evident in opening flower-buds, which are often quite warm to the touch. Plants like the arum are good examples, because of the crowded flowers and the retention of the heat by the enveloping spathe, a rise of from 4° to 10° above the temperature of the surrounding air having been registered, whilst a flowering palm has been known to cause a rise of 68° to 92° Fahr.

With regard to the season of sprouting, it is a most remarkable thing that, as has been shown, although "winter buds" to all appearances are as developed in autumn as in early spring, it is impossible to get them to sprout in autumn or at the beginning of winter. Professor Sachs performed many interesting experiments in this direction, but the earliest he could get them to develop was January or February, by allowing the branches to stand in water in an ordinarily warm room. This was likewise the case with bulbs and potatoes, which he could by no means get to grow before February. Such an inability to grow before a certain time can, he points out, be due only to internal changes, as there are no evident external ones; but as yet no change has been observed between the composition of potato tubers in autumn and in early spring, nor in the reserve food materials of the "resting-spores" of such algæ and fungi as are subject to the same conditions. Sach's hypothesis is a very probable explanation, and is to the effect that this dormancy is due to a slow production of ferments which are necessary to the vigorous chemical changes consequent on germination or sprouting, and that this formation is favoured by cold or dryness, whilst, where germination and activity in spores and buds take place immediately, it is because these ferments are taken up from the mother-plant. As the production of ferments is now receiving considerable attention, this hypothesis will have a chance of being confirmed or rejected. Whatever be the reason, the provision is an extremely valuable one to plant life, for were trees in the habit of budding in winter, the sap would be frequently frozen in the buds, causing death, an event which often happens when in early spring a few warm days cause certain of the buds to open, only to be killed by a return of the cold. A remarkable instance of premature budding is that given by Gilpin, in his "Forest Scenery," of a famous tree known as the Cadenham Oak, growing near the village of Cadenham, in the New Forest. Some opening buds were sent to him on January 15th, 1782, the leaves being about one inch long, two being expanded from some buds and one from others. The people in the neighbourhood believed that the tree would bud only on old Christmas Day, an idea which is entertained also of the Glastonbury Thorn. The buds soon shrink and die with the frost, and no more leaves are produced until the return of vegetation. Mr. F. G. Heath confirms Gilpin's statement, and mentions that he found the Cadenham Oak still living in 1879, though possessing only half its trunk, which had a girth of about 8½ feet. The same property has been attributed also to other trees.

In conclusion, as a slight contribution to the evolutionary side of the subject, a few words concerning what is termed "bud-variation" may not be out of place. Sometimes certain buds will develop in a manner different from that of others on the same plant. It occurs in two different ways, each of which has a different import. In one case the abnormal shoot produced by a variety reverts to the original form; *e.g.*, in the Botanic Garden of Munich there is a beech with divided leaves. This is a backward step. In the other case, new features appear on certain shoots of a plant, as in the myrtle, where single shoots produce their leaves in alternating whorls, instead of in the customary alternate pairs, whilst the branches produced from the axils of these leaves exhibit the ordinary form. This variation must not be confused with such irregularities as differences in the same plant between the sizes and numbers of leaves, flowers, and fruits, which are the result of excessive or deficient nutrition, of a full or an insufficient exposure to air and light. These changes are not hereditary, and do not occur in the descendants of such plants when subject to normal conditions.

Asbestos to Promote Filtration.—Viscid liquids, such as are obtained in processes of artificial digestion, may be filtered, according to W. Fresenius (*Ztsch f. Anal. Chem.*), by the aid of finely picked asbestos fibre. Not only is the filtration of such fluids exceedingly slow, but the filtrate often passes turbid, even through paper of the closest texture. To filter such a fluid, Fresenius advises to dilute with water, add some recently ignited asbestos, and shake the mixture vigorously. After about twelve hours the suspended matters will have subsided, leaving the supernatant liquid perfectly clear. This is to be syphoned off, and the residue to be washed once or twice by decantation, and then passed through a glass funnel, the neck of which contains a pellet of asbestos. If the first part of the filtrate runs off cloudy, it is returned to the funnel until it passes clear.

The Smith Observatory, Geneva, N.Y.—By the liberality of Mr. William Smith, of Geneva, a first-class astronomical observatory has been established at that place, fully equipped with instruments of the highest standard, to be known as the Smith Observatory. Professor Wm. R. Brooks, who is well known for his contributions to astronomical science from the Red House Observatory at Phelps, N.Y., has removed to Geneva, N.Y., where he will in future carry on his astronomical work, under more favourable auspices, as director of the new Smith Observatory. The many valuable discoveries in astronomy heretofore made by Prof. Phelps not only attest his competency and indefatigability, but afford the best promise of success in his new location.

Influence of Forests in Australia.—According to Dr. K. V. Lendenfield (*Petermann's Mittheilungen*), the influence of forests upon the climate of Australia is the reverse of that which they are supposed to exert in Europe. While European trees retain much of the water among their roots, the trees of the Australian wastes send their roots to great depths in search of water, and open their stomata only at night.

General Notes.

PROFESSOR CHEVREUL.—The health of the veteran *savant* is beginning to occasion some anxiety to his friends. He still eats and sleeps well, but he is rather feeble, and has difficulty in ascending stairs.

SUBSIDENCE IN WORCESTERSHIRE.—Owing, it is said, to the insufficiency of props in the underground workings of a colliery some 600 feet below the surface, a subsidence has taken place in the neighbourhood of Cradley. The area affected is about one hundred yards square, and unfortunately it is covered with houses.

UNITED STATES COAST AND GEODETIC SURVEY.—The following publications have recently issued from the offices the Coast and Geodetic Survey, Washington :—"Tide Tables for the Atlantic Coast of the United States for the Year 1889," "Catalogue of Charts and other Publications during 1887," and "The Atlantic Local Coast Pilot, Subdivision 21."

HOUSE-BOATS ON THE THAMES.—The house-boats on the Thames have increased to such an extent that the excrementitious matter and other refuse discharged from them into the river has become a serious item of pollution. The evil is the more serious because the "putrescent and putrescible matters" thus emitted can undergo no kind of purification. The attention of the Thames Conservancy Board has been at last attracted to the nuisance, and measures are being taken for its repression.

THE MOUND-BUILDERS' UNITS OF MEASURE.—According to Mr. R. P. Gregg, quoted in the *Popular Science Monthly*, the ancient Peruvians, the Aztecs, Toltecs, and Central Americans employed a foot equal to $11\frac{3}{4}$ inches English. This foot was divided into twelve equal parts. The mound-builders of Ohio, according to Dr. Abbott, used a foot equal to 10 English inches, also divided into twelve equal parts. Seven of the Ohio inches were thus equal to six Peruvian inches.

REFRIGERATING MIXTURES WITH SOLID CARBONIC ACID.—According to MM. Cailletet and Colardeau, flocculent carbonic acid is capable of cooling bodies down to -60° Centigrade at the ordinary pressure of the atmosphere, and down to -76° in a vacuum. If the solid carbonic acid is mixed with ether the temperatures are -77° and -103°. If chloride of methyl is used instead, of ether there is obtained a temperature of -82° at the pressure of the atmosphere, and of -106° C. in a vacuum which is equal to 190° below freezing or 158° below zero on Fahrenheit's scale.

DETECTION OF GAS-LEAKAGE.—The use of matches or other lights to detect an escape of gas is not free from danger. A test-paper for detecting such leakage has been devised by Dr. Bunte, improved by Herr Schauffers, and is published in *Invention*. The paper is steeped in alcohol, containing to every three parts chloride of palladium one part chloride of gold. One pint costs 9s., and will steep filter paper enough for 10,000 tests. The observer may be misled if there is present tobacco smoke, a smoky chimney, fusel oil, the smell of onions, sulphuretted hydrogen, or the vapour of mercury.

ABSORPTION OF GASES BY CARBON.—From analogy we should expect that chemical action within carbon filaments is very possible, since, however carefully they have been prepared, a greal volume of gases must be condensed in their texture. Smith and Reichardt report that the gas which these carbons give off is carbonic acid, the more abundant the moister is the air. Baker has since established that in perfectly dry air carbonic oxide only is evolved. In any case a combination of carbon and oxygen takes place, which accounts for the gradual deterioration of the filaments in incandescence lamps.

EXPLORATION IN MOROCCO.—The following message sent to the coast by special courier, by Messrs. Joseph Thomson and Harold Crichton-Browne, and forwarded from Tangier by the Eastern Telegraph Company's cable, has been transmitted by Sir James Anderson to the Royal Geographical Society :—"Left Demnat June 5th, followed the glen of the Wad Gadat to the Tilnet, which we crossed at a height of 8,000 ft. Reached the house of the Governor of Ghaoria on the 8th; magnificent reception; all goes well; prospects good; remain here for a few days.

FLIES AS COMMUNICATORS OF DISEASE.—Dr. Hoffmann, of Dresden, confirms the statement that the common house-fly distributes the bacillus of tubercle. In a ward occupied by phthisical patients, four out of six flies caught were found to contain the bacillus in their intestines. The insects collect the microbia from the expectorated matter, and discharge them again unhurt. The *Medical Press* appends to this paragraph the following curious moral: "Abstain from eating flies or their excreta, and bottle up all phthisical sputa." Would it not be better to say treat all such sputa with corrosive sublimate or strong sulphuric acid?

HYPNOTISM AS AN AMUSEMENT.—By way of emphasizing the caution which we gave (vol. i., p. 621), we quote from the *Monthly Magazine of Pharmacy* the following paragraph :—"A well-connected young man, who lives with his mother in a fashionable part of Paris, recently attended what is called a *soirée d'hypnotisme* at a friend's house. He went to sleep, and a stuffed mannikin was placed by his side, which he was told was a man, whom he must murder. The youth did as he was told, and when a knife was put into his hand he ripped the dummy figure open with the exultation of a man who was wreaking a long-cherished revenge on an enemy. After that he awoke, but ever since he has been labouring under the delusion that he murdered his mother. He ran away from his home, and sat weeping on a bench in the Champs Elysées, when two policemen, whose curiosity had been excited, came up to him. On seeing the agents of the law the poor fellow took to his heels, and was, of course, pursued and arrested. It was only when he was brought face to face with his mother that he regained his senses."

PURCHASED RESEARCH.—"We regret," says the *American Naturalist*, "to read in our esteemed contemporary, the American *Geologist*, an editorial apology for a practice which scientific men condemn. We refer to the purchase of the scientific work of a man, and the publication of it by the purchaser as though it was his own production. While this kind of contract is perhaps legal, it is disreputable to the purchaser. A man under necessity for the means of a livelihood may make such a sale of himself without blame, but the man who buys cannot in any way get a sound scientific reputation. But, whatever the law may be, the moral obliquity and intellectual poverty that such a transaction implies on the part of the purchaser are too plain for dispute. We must here draw a distinction. If, as it sometimes happens, a man of science comes upon certain ideas and hands them over to an assistant to work out, giving him instructions how this is to be done, we must hold that the originator retains by right the credit of the work. The relation of the two is like that of the architect and the mason. But if a man buys, as our worthy contemporary intimates, what he has neither conceived nor executed, and publishes it as his own, he is simply an impostor."

The Longitude of Paris.—We understand that the details of arrangement for redetermining the difference of longitude between Paris and Greenwich have been settled between the Astronomer Royal and Mr. Lœwy, of the Bureau des Longitudes and Paris Observatory. It has been decided to use the geodetic station at Montsouris, which has already been connected with several important points in Europe, as the French station and the Royal Observatory as the British. Two English and two French observers will take part in the operations, which will probably commence in September next. In 1854 the work was done by one observer from each observatory, the observations being made by the observer noting the time and estimating the fractions of seconds at which the stars used passed over the wires of the transit instruments, and galvanometer needles were deflected. On the present occasion the transits and times of deflection will be registered on chronographs. This work is looked upon as most important by astronomers and geodesists, as it will connect Greenwich with the continental surveys which have of recent years been made with a very high degree of accuracy.

Archæological Find in a Peat Moss.—On Thursday, June 28th, the workmen employed by Mr. Gordon, of Fowlisters, in cutting peat in the moss, "Hen Heads," on the westmost shoulder of the Hill of Aultmore, dug out from the moss a large kit of fatty matter, which had certainly been placed there by some of the inhabitants of that district a very long time ago, as about fifteen feet of moss had grown on the top of the place where it was found. This fatty matter was encased in a jar made of tree bark and surrounded with a basket of wicker work, some of the wattles of which were nicely plaited together. The matter, which is quite hard round the outer edge, is somewhat in the form of a miniature corn rick, tapered to the point from the rim of the jar. The thick part of the body, which, from the impression of the bark jar, resembles in appearance part of the trunk of a tree, measures in circumference 5ft. 6in. and in height about 3ft. 5in., and weighs nearly 2cwt. Unfortunately one of the workmen, actuated no doubt by a desire to see if there was anything worth looking after inside, cut off the top, which act has marred the original form considerably. Nothing, however, was found inside. The whole contents seems to have been a solid mass of prepared fat, which time has turned into what is known now as adipocere. The whole find has been carefully deposited in the Keith Museum.

Sophisticated Wine.—The death of eleven persons in the South of France, traceable to arsenic in the wine sold by a local merchant, has directed attention to a new process of sophisticating wine. *Mouillage* has long been a custom in the trade. It consists in multiplying the quantity of a good wine in the following manner: A quantity of good wine is purchased, and to it is added an equal quantity of a much cheaper sort. Sometimes water is also added. This is the *mouillage.* The process does not, however, end here, for the eye and the palate of a fairly good judge, to say nothing of the analyst, would easily detect the fraud. The doctored wine is flat to the taste, and spoiled in colour. The palate of the taster and the skill of the analyst have now to be cheated. This is effected by adding alcohol. Sometimes the alcohol is added pure; sometimes it is introduced in the form of glucose from which alcohol is derived by fermentation. There remains the colour. Those who have travelled much in France may have noticed acres of tall flowers called hollyhocks, and wondered for what purpose they were grown. The petals of these flowers afford a decoction which is capable of restoring the colour to the wine without revealing its presence to the chemical analyst. This was the old and harmless method; but it appears that we have grown less scrupulous and less careful, for in the case of the wine which occasioned the deaths alluded to, it was found that coal tar colours had been substituted for the hollyhock petals. The matter is yet under investigation; but it is said that some arsenic was contained in the colouring agent.—*Industries.*

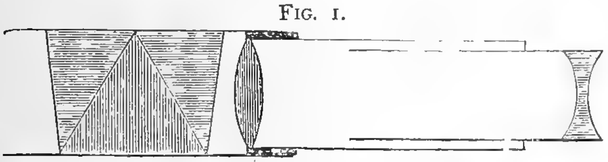
The Public Health.—The Registrar-General's return for the week ending July 7th shows that the deaths registered last week in 28 great towns of England and Wales correspond to an annual rate of 15·0 per 1,000 of their aggregate population, which is estimated at 9,398,273 persons in the middle of this year. The six healthiest places were Brighton, Nottingham, Leicester, Birkenhead, Huddersfield, and Halifax. In London 2,348 births and 1,211 deaths were registered. Allowance made for increase of population, the births were 332, and the deaths 372, below the average numbers in the corresponding weeks of the last ten years. The annual death-rate per 1,000 from all causes, which had been 14·5 and 15·1 in the preceding two weeks, declined again last week to 14·8. During the 13 weeks of last quarter the death-rate averaged 16·9 per 1,000, which was 3·0 below the mean rate in the corresponding periods of the ten years 1878-87. The 1,211 deaths included 23 from measles, ten from scarlet fever, 29 from diphtheria, 31 from whooping-cough, 7 from enteric fever, 2 from ill-defined forms of continued fever, 51 from diarrhœa and dysentery, 3 from cholera and choleraic diarrhœa, and not one from small-pox or from typhus; thus, 156 deaths were referred to these diseases, being 175 below the corrected average weekly number. In Greater London, 3,130 births and 1,502 deaths were registered, corresponding to annual rates of 29·5 and 14·2 per 1,000 of the population. In the Outer Ring six deaths from diphtheria and six from whooping-cough were registered. The fatal cases of diphtheria included two in Tottenham and two in Walthamstow sub-districts.

SPECTRO-TELEGRAPHY.

SPECTRO-TELEGRAPHY is the name of a new invention by Paul la Cour, the inventor of the phonic wheel, and its synchronism for multiplex telegraphy. The instruments are shown at work at the present moment in the Copenhagen Industrial Exhibition, and the invention, which is patented, is based upon quite a new principle. It may be used for several purposes, but I shall here confine myself to pointing out and describing in detail the application of the system to nautical use as a simple means of communication from lighthouse to ship, and *vice versa*, and between ships themselves.

It is well known that such a signal system exists, but it is only available in the daytime. The first idea was originated in England, in 1857, it was taken up by France, and afterwards by nearly all maritime nations, and is known as the international flag system. Generally speaking, the signals are not meant to express words and sentences by spelling, but only to give a limited, though very large number of sentences, which are arranged in a signal book (international code of signals). It has the advantage, however, that each vessel can carry

FIG. 1.



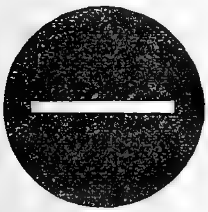


FIG. 2.

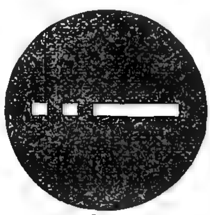


FIG. 3.

a signal-book in its own language, and two ships of different nationalities are thus enabled to correspond without understanding each other's language.

The signalling is accomplished by means of 18 flags and pennants, each of which indicates one of the letters, B, C, D, F, G, H, J, K, L, M, N, P, Q, R, S, T, V, W. Of these are then formed two, three, or four-flags signals, respectively, in the number of 306, 4,896, and 73,440. All the two and three-flags signals and the first 18,960 of the four flags are intended for the different communications, queries, and answers. The others are reserved as "distinguishing signals" for ships, 1,440 for men-of-war, and 53,040 for trading vessels.

The large extension which this system has attained in a comparatively short period is a proof of its practical arrangement; still it has one disadvantage, namely, it is useless at night, and yet ships sail as much then as in the day. The value of this mode of correspondence is thus reduced one-half, and an owner wishing to give final instructions to his captain by this means, hesitates in doing so, as he is not certain that his ship may pass the lighthouse in the day.

La Cour's system is not intended to supersede the present flag system, but to supplement it in the night. This invention enables us to utilise a corresponding *modus operandi* at night by means of the same signal-book, and in such a way that the night duty becomes as simple as the day duty, and even possesses certain advantages over the latter.

When we observe a distant white light, a star, or the light from a lighthouse through a prism with vertical edge, then such a light, as is well known, appears as a horizontal luminous line, consisting of red, orange, yellow, green, blue, indigo, and violet-coloured rays. Sir Isaac Newton discovered that this was owing to the fact that the white light in reality is a combination of all these colours, with their infinitely many shades, and that they are refracted differently in the prism and thus separated, whilst they can again be combined and reproduce the white light.

Instead of a simple, a compound prism may be used. The latter separates the colour rays, but does not, on the whole, deflect them much from their original direction, and such a prism fixed on a telescope (fig. 1) is specially adapted to dissolve the in-going light. When a distant *white* spot of light is observed through this, a luminous line (fig. 2) is seen in the field of the telsecope, *coloured from red to violet.*

If now the person *who is sending* the light signal is able to arrange, in a simple manner, that all the

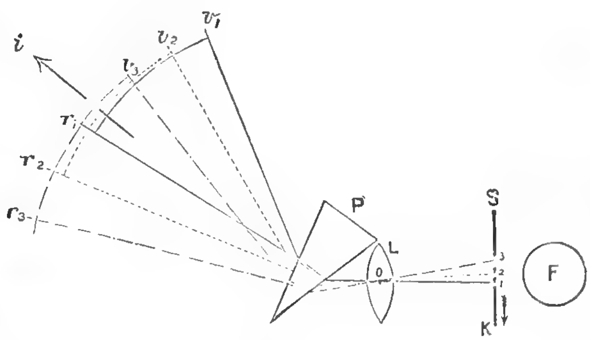


FIG. 4.

colour rays are not emitted, but only some, while others are entirely removed, it can be so managed that the remaining part of the spectrum appears as a distinct signal, for instance the Morse signal - - —— (fig. 3.) This is exceedingly easy to decipher, and does not even require colour sense, for although it is differently coloured, yet it is only the shape which is of importance (the colours are the only means of providing the conventional shape), and the signal can be read by any one, even the colour blind.

The sending instrument is represented diagramatically in fig. 4, which shows a horizontal section of the instrument (it is about 1 foot high and long, and 8 inches wide), together with the rays of light on their road to the horizon. F is the lamp, S, K is the screen, in which openings are cut corresponding to the signals to be sent, for instance, two small openings (1 and 2) and one wide (3), corresponding to the signal - - ——. L is a lens, the distance of which from S, K is equal to its focal length. Therefore all the rays of light which, passing through the opening I, strike the lens L, will, after travelling through it, become parallel with the line, 1—o, from the opening, 1, to the optical centre of the lens (o). The other rays of light are therefore not shown, for they have the same direction as 1—o. This ray of light will then strike the prism P, and be refracted and spread, so that it forms the coloured, fan-shaped rays of light r_1, v_1, containing all the colours. In the direction of the distant observer, *i*, a distinct colour only will be emitted from the opening 1, say *orange;* from the opening 2, there will also be rays emitted, which are first made parallel by the lens, and afterwards spread by the prism in the fan-shape r_2, v_2, of which a single colour only strikes *i*, say *yellow*. In the same way the opening, 3, produces the fan-shape r_3, v_3, but this opening being wider, *i* will receive several kinds of *green* and *blue* rays.

To the naked eye, or with an ordinary telescope, the light which issues in the direction *i*, will give shapes of colour corresponding to a mixture of the respective colours; but if the spectro-telegraphic telescope is used, the signal appears as in fig. 3.

When the sender moves the screen S, K, in the direction indicated by the arrow, opening 3 will take opening 2's place, opening 2 takes 1's place, and in the field of the telescope the receiver will also see the line of light 3, slide smoothly into 2's place, etc., etc., so that the signals are seen to glide through the field, in at one side and out at the other.

To perfect the present system of signalling, and use La Cour's signals at night, a sending instrument, with the eighteen perforated metal pieces, together with the receiving telescope is only required. Instead of hoisting the four flags in the daytime, signifying, for instance, C, F, G, L, the four corresponding pieces of metal need only be inserted in the sending lantern, and made to move backwards and forwards several times, so that the receiver has time to read them.

These night signals are in some respects superior to the day signals. They are, for example, not diminished by distance, as their size only depends upon the receiving telescope, so that however far they are sent they keep the same dimensions. They are also independent of the direction of the wind, which often disturbs the flag signals by making them turn edgeways to the observer so that he cannot see them.

This same system has been tried for ordinary telegraphy by passing a perforated slip (as in the Wheatstone's transmitter) through the sending instrument, and a telegraphist can read these marks so easily, that the telegraphing can be performed with the same speed as with an ordinary Morse instrument.

It is well known that a hazy atmosphere first obliterates the violet and blue rays of light; it has therefore been supposed by some that spectro-telegraphy would fail under these circumstances. This is, however, not so, for as the signals seem to glide through the whole spectrum, they can always be read in the red, yellow, and green, even if they are lost in the violet and blue.

This principle also appears to be applicable in several different ways. If a lighthouse be supplied with a sending instrument, in which the first letter or letters of the light's name are placed, the mariner will always be able to see in the spectro-telegraphic telescope what light it is, and thus mistakes and loss may often be prevented.

Further, an entrance to a harbour does not need to be indicated by *two* lights, which direct the course, but by *one* only of La Cour's system, with a fixed signal or letter, which is only seen in the middle of one's telescope, if one is exactly on the right track. By steering a little to the one side or the other, the letter or signal will appear to glide in the telescope to either of the two sides and if the ship passes entirely out of the proper course the signal disappears from the field of the telescope. Another advantage in this method is, that the light from the harbour lantern is very easily distinguished from all other lights, for these latter appear in the telescope as a continuous light from red to violet, whereas the former gives its own peculiar signal, for example - —— - ——.

Finally, ships might be supplied with a fixed lantern of this kind, which throws light forward, and obliquely to the sides. Two ships going in opposite directions will thus in their telescopes immediately see whether their course lies to the starboard or port of each other, and also whether they are in the act of altering their helms, for the letters in the telescope will then appear to glide to one side or the other.—*Electrical Review.*

THE ELASTIC LIMIT OF IRON AND STEEL.—An interesting series of experiments on the alteration of the elastic limit of iron and steel, which have now extended over several years, have been made by Professor Bauschinger at the laboratory of the Technical High School at Munich, and some very interesting and important results have been obtained. Most of the experiments were made on one of Werder's testing machines, the deformation being read by Professor Bauschinger's mirror apparatus, but for the experiments on the endurance of bars a Woehler machine has been employed. In the course of these experiments it was discovered that the break-down point of a bar had no connection with the elastic limit: thus, when a series of gradually-increasing stresses, exceeding that corresponding to the original break-down point of the material were applied to the bar, this point rose with the stress, and this rise was continued for weeks and months, and possibly years, if the bar was left at rest under the greatest of these loads. On the other hand, when a bar was subjected to an increasing stress, greater than that corresponding to the elastic limit of the material, but less than the stress at the breaking-down point, the elastic limit and elastic modulus both increased, but reached a maximum as the breaking-down point was approached, and then rapidly decreased, the former at times even reaching the value of zero. If, however, the bar is left at rest under a stress exceeding that of the primitive breaking-down point, the elastic limit and elastic modulus increase again, and the former may attain a point far above its original value. Moreover, the limit in elastic tension is, in general, very different from that of the material when subjected to compression, and artificially raising the elastic limit in tension, as described above, causes the limit in compression to be decreased, and this may even pass through the point of zero stress. In other words, a bar of steel or iron has two elastic limits, and whatever position these occupy on the scale of loads, the range between them is nearly a constant quantity. By alternately stressing a bar in tension and compression just beyond the elastic limits, these, after a certain number of repetitions, occupied positions equally distinct from the point of zero load, and the limits thus obtained are called by Bauschinger the natural elastic limits of the bar. It was then noted that the stress corresponding to these limits sensibly coincided with that found by Woehler as the limiting stress to which a bar could be subjected to alternate tension and compression. It would thus appear that a bar would bear an indefinite number of repetitions of stress, provided the range of stress does not exceed the elastic range mentioned above.—*Glasgow Engineer.*

HAWICK SCIENTIFIC AND PHILOSOPHICAL SOCIETY.—At the annual general meeting the following gentlemen were elected officers and council of the society:—President, Mr. John Berry, Stewartfield; Vice-President, Mr. James Gowans, jun.; extra Vice-Presidents, Mr. W. S. Irving and Mr. John N. Lamb; Secretary, Mr. John N. Lamb; Assistant Secretary, Mr. David Miles; Treasurer, Mr. W. C. Goodfellow; Council, Messrs. A. Blackwood, A. Huggan, W. S. Irving, W. Sinclair, R. Watson, and Jas. Young.

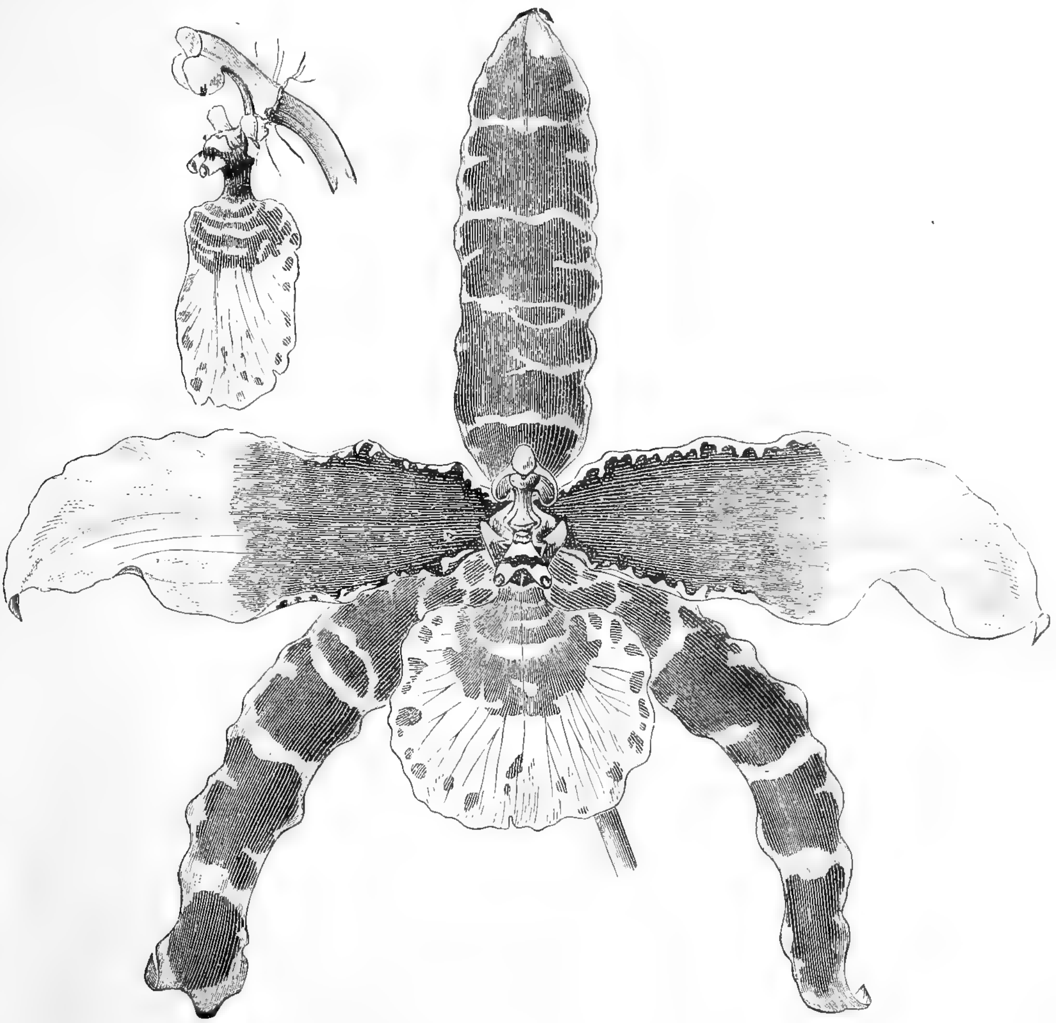
Natural History.

THE ORCHIDS: WHAT ARE THEY?

(Continued from p. 36.)

AMONG the cultivators of orchids these plants are commonly divided into a "cool" and a "hot" group, a classification based, not upon any structural distinction, but upon the temperature which they require. The "cool" orchids are almost exclusively natives of the western hemisphere, where they extend from lat. 20° N. to 30° S. In South and Central America, high temperatures of course prevail in the plains, but the bulk of the "cool" orchidaceous plants which we encounter in European conservatories are natives of the mountains, some of them extending to the altitude of 9,000 feet above the sea-level, whilst some of the small-flowering species which grow not on the trunks of trees, but upon rocks, or even in the ground, like the orchids of Europe, may be found at heights even of 11,000 or 12,000 feet.

Of the "cool" orchids the most noteworthy genera are Odontoglossum, Cattleya, and Laelia. The first-mentioned genus includes some of the most popular species of the entire family. Some idea of its general structure may be formed from our figure on p. 35, though even carefully coloured illustrations can convey but an imperfect conception of the beauty of most of the plants. The technical characteristics of Odontoglossum are: *sepals* spreading and free, the lateral ones rarely united at their bases; *petals* generally of the same size as the sepals, though sometimes broader; *lip*, parallel with the column at the base; the intermediate lobe or limb, either spreading or deflexed, and furnished with a fleshy crest near the base. *Column*, club-shaped, often elongate, usually narrow at base, sometimes expanded into a membranous wing on each side, or into auricles at base, or wingless. *Pollinia*, two, pear-shaped or ovoid, united by a linear or flattened caudicle to an oval viscid disc or gland. *Capsule* variable in form, but usually ovoid or oblong, and often rostrate.



ODONTOGLOSSUM GRANDE. (After Veitch.)

As regards their colouration, we may say that *Od. blandum*, the species which we figured in our last number, has its sepals and petals white, spotted with reddish purple, whilst the white lip displays bright yellow streaks.

The *Odontoglossum grande*, an illustration of which we are enabled to give through the courtesy of Messrs. Veitch, is the largest flowered of all the known Odontoglots. It was found in 1839 by Mr. G. Ure Skinner, in dark ravines near the city of Guatemala, in situations where it was secure of moisture and constant shade. The flowers are from 5 to 6 inches across, the sepals are bright yellow, barred with cinnamon-brown; the basal half of the petals is cinnamon-brown, bordered with yellow, the other half bright yellow; the lip is pale yellow, and the fleshy crest an orange yellow.

The species of *Odontoglossum* form an indefinite number of hybrid forms, which require much further study before we can hope to reach any general law concerning their production. Mr. Veitch remarks that "notwithstanding the investigations of Darwin, Müller, and others had resulted in a very considerable modification of the belief in the fixity of species, the first appearance of these hybrid odontoglots was to many orchidologists a surprise and a puzzle." Further:—"From the first it has been observed of these natural hybrids that it is an extremely rare occurrence for any two appearing in different importations to be identical, although apparently derived from the same two species, and sometimes even sufficiently like each other to come under the same name. Nor ought this to be wondered at; the agency by which these hybrids and polymorphisms have been produced has been in operation for ages past, and it cannot but have happened that a large number of these forms, both of those that are known and of those hereafter to be brought to light, are not the immediate offspring of two recognised species or more primitive types, but are descended from their mixed progeny, further complicated by an occasional cross with one or other of themselves. Hence we already possess a number of forms that are 'confluent in series,' of which the extremes are too widely separated for the interval to be covered by one, two, or even more intermediate forms."

The headquarters of the great genus *Odontoglossum* are in the more eastern portion of New Granada, stretching from Bogota towards Ocaña, the valleys of the Cauca and the Magdalena being especially rich.

(*To be continued.*)

Aquatic Caterpillars.—A number of instances are on record of catterpillars that normally descend beneath the surface of the water to feed upon submerged plants. One of the best known is an Argama, which feeds on the leaf-stalks of water-lilies, and which was observed by Prof. Comstock several years back. Though these insects spend a large part of their time under water, they are obliged to come up to the surface at intervals for a supply of fresh air. Some caterpillars, however, are more truly aquatic. One of these, *Paraponyx stratiotalis*, was described by De Geer more than a century ago. Another from Brazil, *Cataclysta pyropalis*, which, like the former, belongs to the family *Pyralidæ*, was described, in 1884, by W. Muller, of Blumenau. In a recent number of the *American Naturalist* is an account of a third species, described by Prof. Wood-Mason in a pamphlet, entitled *Report on Paraponyx oryzalis, an Insect-pest of the Rice-plant in Burma.*

A Cow with only one Kidney.—Dr. H. Shimer (*American Naturalist*) lately saw killed a healthy cow which had only one kidney—the right one. It was double the usual size and weight, being 11 inches in length and $2\frac{1}{4}$ lbs. in weight.

Mineral Matters Consumed by Animals.—It is commonly said that animals, unlike plants, are not able to assimilate inorganic matter. Experiments at Rothamsted show that pigs fed on corn-meal alone did not do well until a mixture of coal-ashes, salt, and superphosphate of lime was given them, which gave the most satisfactory results, both as to the health of the animals and their progress in feeding.

Gigantic Sponge.—It is announced that a spherical sponge, $10\frac{1}{2}$ feet in circumference, has been fished up in the Mediterranean and brought to London.

A Redeeming Feature of the "Blizzard."—According to Mr. E. Ingersoll (*Field*), the fearful blizzard which visited New York in March has destroyed many of the European sparrows which had been so foolishly introduced into America, and are there proving so severe a nuisance.

The Pyralidæ of Japan.—The magnificent collection of Japanese *Pyralidæ* formed by the late Henry Pryer, and containing 4,000 specimens and more than 375 species, many of them probably new to science, has been purchased by Dr. W. J. Holland, of the American Eclipse Expedition. It is to be regretted that this collection did not find its way to the British Museum.

The Golden Oriole in Britain.—Mr. Kerr records in the *Newcastle Weekly Chronicle* that the golden oriole has been seen—and of course massacred—in several parts of England. The great obstacle to the re-establishment of this beautiful bird among us is the "British mania." Egg collectors are found willing to give from 20s. to 25s. for an egg of this species, if only they are told that it has been laid in Britain. A bird "in the flesh" fetches still more. No similar folly prevails in any other country, and until it can be exorcised, the preservation of rare birds and insects will be found impossible.

THE NATURALIST AT THE SEA-SIDE.

II.—The Marine Dredge.

Years ago the writer's enthusiasm for dredging was kindled by Edward Forbes' charming descriptions. It is truly a delightful occupation, and, after years of occasional practice, the old excitement comes back again and again. The lap of the waves against the side of the boat, the rush of sparkling water, and the eager expectancy with which the hauling in is done, beat all the pleasures of the angler. The marine dredge need not be described, for it is figured in many common books, and it is a well-known article in the market. Any boat will do that is big enough. A large coble, or a small steamboat, are what the naturalist commonly employs. Lucky, indeed, are they who have a steam-winch for winding up the dredge!

The western shores of our islands are by far the best for the purpose, and the west coast of Scotland is the paradise of the dredger. A likely spot is found by consulting the Admiralty chart. Sand is avoided as barren. A rocky bottom is dangerous to the dredge, and special precautions must be taken here, such as tying one handle with string instead of rope, so as to give the dredge an extra chance of freeing itself. The boat is kept just moving, and, when all is ready, over goes the dredge, a few feet of chain being commonly fastened to the rope, not far from the handles, to keep the iron jaws well down upon the bottom. We flop about for half an hour or so in a manner very unpleasant to those who are liable to sea-sickness, or who don't care about the work in hand. Now and then it is well to pull the rope, and feel whether all is right. The grating of the dredge on the bottom is quite perceptible to an experienced hand. At length the word is given to haul in. All hands are called to pull, and slowly, foot by foot, the wet rope climbs to the top. One big heave at the last, and the dredge lies on deck. Often it is absolutely empty; often it is choked with tangle or dead shells, or useless shingle. But the lucky casts make amends for many a failure. The most promising indications are a good number of Echinoderms (starfishes and echini) or broken fragments of pink nullipore. Then the contents are spread out, and the collectors, kneeling on the sloppy deck, rummage for treasures. Pails of salt water, glass plum-jars, tubes of all sizes, and watch-glasses are at hand. Big things are piled up in the pails, delicate creatures which can hardly bear the lightest touch are carefully placed in separate tubes. Meanwhile some thoughtful soul takes compass-bearings of two conspicuous points, so that another trial may be made in the same place. If the weather is tolerable, and the fishing profitable, hour after hour slips by unnoticed. There are fifty things to do, and every moment is precious. At last everybody's strength is worn out. The back refuses to stoop any longer, the knees are bruised, the fingers benumbed. A sailor's meal of boiling-hot tea and biscuits is served out, pipes are lit, and the sense of having enriched one's collections, and laid up happy employment for many a coming winter evening, is a fit reward for all toil and anxiety.

Like all work that is done at sea, dredging is full of uncertainties. Make no promise as to the hour of return. If you come back empty-handed that is nothing; but if you have a touch of enthusiasm, and are fond of hard work—if you like a life in which no day is like any other—and if a new animal sends a thrill of delight through your frame, set up a dredge and go to sea as often as you can.

THE EDISON AND SWAN ELECTRIC LIGHT COMPANY *v.* HOLLAND.

AFTER occupying no less than twenty-two days of the Court of Chancery, and affording opportunity for the display of the talents of some of the leading members of the bar, a most important patent suit, and one which will be of historical importance, has been decided by Mr. Justice Kay. A case in which the Attorney-General (Sir Richard Webster, Q.C., M.P.), Mr. Aston, Q.C., Mr. Moulton, Q.C., appeared for the plaintiffs, and secured among their witnesses and experts Sir Frederick Bramwell, Dr. J. Hopkinson, Mr. I. Imray, and Professor Dewar, and in which the defendants were represented by Sir Horace Davey, Q.C., Mr. Finlay, Q.C., M.P., with the assistance of Professor Crookes, Professor Frankland, Dr. Meymott Tidy, Professor Silvanus P. Thompson, Professor Perry, besides junior counsel and many other well-known electrical engineers, naturally attracted considerable attention both from other barristers and persons interested in the case.

The Edison and Swan United Electric Light Company sued Mr. W. Holland, the Manager of the Alexandra Palace, for using electric glow lamps which were alleged to be infringements of Edison's patent, No. 4,576, of 1879, and of a patent of Sawyer and Mann, taken out in the name of Cheeseborough, a patent agent. Mr. Holland was guaranteed against liability by the Jablochkoff Company, who had supplied him with the lamps, and they in turn were guaranteed by the Anglo-American Brush Company, by whom they were manufactured. The Brush Company were, therefore, practically the defendants.

The Edison specification describes the manufacture of filaments for glow lamps from paper, vegetable fibre, splints of wood, or from a thread rolled from a mixture of lampblack moistened with tar, and "kneaded till it assumes the consistency of thick putty." It is directed that the filaments are to be "carbonised in a closed chamber by subjecting it to a high heat." The claims are: "Firstly, an electric lamp for giving light by incandescence, consisting of a filament of carbon of high resistance, made as described, and secured to metallic wires as set forth. Secondly, the combination of a carbon filament within a receiver made entirely of glass, through which the leading wires pass, and from which the air is exhausted, for the purposes set forth. Thirdly, a coiled carbon filament or strip arranged in such a manner that only a portion of the surface of such a carbon conductor shall radiate light, as set forth. Fourthly, the method herein described of securing the platina contact wires to the carbon filament, and carbonising of the whole in a closed chamber, substantially as set forth."

In defence it was sought to prove that the patent was anticipated by Mr. Swan, of Newcastle. This gentleman had begun to experiment with carbonised paper strips for the purpose of producing light by incandescence as early as the year 1845. With a better air pump he repeated his experiments, and in the autumn of 1877 he met Mr. Stearn, who was very skilful in the use of the Sprengel air pump, by which an extremely perfect vacuum can be produced. At a lecture in February, 1879, Mr. Swan exhibited a lamp which was produced in court, and which is well described by the first and second claims of Edison's patent. Edison was at this time creating a scare with a worthless lamp consisting of a platinum wire, and succeeded in producing a panic in gas shares; he evidently did not know what Swan and Lane-Fox were doing in this country, and he soon found that a filament of platinum was useless, and turned his attention to carbon. The two English inventors were now on the right track, but had not succeeded in producing a really satisfactory lamp. Swan, though he exhibited very interesting lamps at several lectures, did not appear to think that the combination of a carbon conductor in a vessel wholly of glass, from which the air was exhausted, was sufficiently novel for a patent. In a letter to Mr. Stearn, he said that he had heard that Edison was experimenting with carbon, and he feared that he would forestall him. Invention followed invention so fast, that one method was superseded by another before it could be brought before the public. It is certain that the first Edison lamps that were seen in Europe were at the Paris Electrical Exhibition in 1881. These, however, had fine strips of bamboo, and were made under a subsequent patent. No lamps made according to the patent in question, ever appear to have been sold, or indeed were ever made in this country *except for the purpose of evidence in litigation.* To make them was no easy task. Professor Crookes, whose skill in delicate manipulations is as great as his reputation as a chemist, was no more successful in his attempts than were Professor Silvanus P. Thompson, Dr. Tidy, and others. Filaments were reduced to ashes, putty of tar and lamp-black refused to be rolled out to a thinner thread than one twenty-fifth of an inch, and lamps which with the greatest difficulty were at length made and tried, broke down after a minute or two. Mr. Gimingham, for the plaintiffs, however, seemed to have little difficulty in making any number of the lamps. Professor Dewar rolled out a fine filament in the witness-box from a "tar putty" which he brought with him. With such conflicting evidence, the judge ordered that the experiments should be repeated by two experts from each side, in the presence of counsel and of an independent "moderator." Professor Stokes was selected for this office, and he sent an extremely interesting report to the judge. It turned out that this "putty" must be kneaded and worked with a considerable expenditure of force for about an hour and a half. It then assumes the consistency of gutta-percha, and can be rolled out. But of one hundred lamps made of this substance some broke down as soon as the electric current was turned on. Eleven lasted less than twenty hours, eighteen could not stand forty hours' run, and after sixty hours only four survived.

In a most masterly judgment, in which Justice Kay showed that he had made himself thoroughly conversant both with the theory of the subject and with the most minute details, he decided that Edison's patent was void for six reasons. First, that the claims were too wide. Second, that it does not describe a lamp which has met with a commercial success. Third, that there is an insufficient description of the processes of manufacture. Fourth, that in one of the processes described, by which volatile substances, such as camphor, are mixed with the "tar putty," the presence of such substances would be injurious. Fifth, that the use of certain "nonconducting noncarbonisable substances," which it was said might be used as a coating to the filaments, were of no utility. And sixthly, that the coiling of the filaments as described by Edison, was also of no utility. Judgment was therefore given for the defendants with costs.

The invention of Sawyer and Mann is for a most ingenious and beautiful process of depositing carbon upon a filament of an electric lamp. The bulb is filled with a hydrocarbon gas or liquid; coal gas is often used, and the filament is "flashed" by passing a current through it. If one part be thinner than another, this will offer more resistance to the passage of the current than will the thicker parts. The temperature will therefore be greater, and the heat will decompose the hydrocarbon, the carbon of which is deposited on the heated part. It is clear that this process is perfectly automatic, and the result is a great uniformity throughout the filament, each part glowing with the same brilliancy. The defendants say that their filaments are so regular that it is very rarely that they could be improved as far as uniformity is concerned, but that they use this process to deposit a coat of carbon on the filaments in order that their resistance may be made the same, so that a number of lamps will give the same light. They admitted that if there were by accident any flaw in a filament, this "flashing" would remedy it. They endeavoured to show that the invention had been anticipated by the French chemist Depretz, who, in trying to fuse carbon by the passage of a strong current of electricity, surrounded it with a hydrocarbon gas, and found that it increased in size. Not only was this discovery of no apparent use, but it interfered with Depretz's experiment. The patent was therefore upheld, and an injunction was given restraining the defendants from using the process, and they were ordered to pay the proportion of costs.

This case, which has excited a considerable amount of interest, thus throws open the manufacture of incandescent lamps, as far as the elementary use of a high resistance carbon filament in a vacuum is concerned, but there are a considerable number of patents for such details as the "flashing" process, which will probably render it improbable that the fancy price of 5s. each will be at once reduced to a more reasonable sum.

At an early stage of the case, Mr. Percy Sellon gave a full account of the process of manufacture of the lamps as made by the Anglo-American Brush Company. The material from which the filament is prepared is cellulose in an extremely pure condition. It is formed by dissolving ordinary cotton wool (which consists almost entirely of cellulose), in a solution of chloride of zinc. By the application of heat this produces a viscous semi-liquid mass, the fibres and cellular structure being destroyed, as in the materials called "vulcanised fibre" and "Willesden paper." The material, which is then not unlike a strong solution of gum arabic, is then forced through a small hole or die by the pressure of a column of mercury. It is received as it issues from the hole in alcohol, which both stiffens or congeals the thread, and removes any chloride of zinc that may be present. It is then left to soak in another jar of alcohol, and is allowed to dry. It has the appearance of fine gut as used for fishing. It is wound on wooden drums covered with velvet, which yields to the thread as it contracts while drying. It is then wound on a block of plumbago, provided with a piece of cardboard at one end, and the whole is placed in a plumbago crucible, and is packed with powdered plumbago, a little paraffin wax being placed at the bottom of the crucible. It is then closed and placed in a furnace, and gradually raised to a white heat, which is attained after about six hours. The paraffin vaporises and drives off the air contained between the interstices of the plumbago, and the piece of cardboard consumes, and allows the filaments to contract. The temperature is raised to a fierce heat for some hours, the total period in the furnace being about eleven to fourteen hours.

The crucible with its contents are allowed to cool, and the filaments are taken out and separated. They are "flashed" as has been described, the resistance being measured between the flashings, which are repeated until the right standard is attained. They are then permanently mounted on the platinum wires, which are coiled at one end into a spiral, into which the carbon filament is pushed. A local flashing is then applied, the current being diverted from the filament itself by a bridge of wire. The junction alone, which offers some little resistance, becomes heated, and the deposit of carbon takes place, sealing the filament to the wire. The wires are then sealed into the glass bulb, and the air is exhausted, the lamp being subjected to a current during the latter part of the operation, thus driving off any gas which is "occluded" by the carbon or the platinum.

THE VAGUE CRY FOR TECHNICAL EDUCATION.

UNDER this heading Lord Armstrong contributes a short article in the July number of the *Nineteenth Century*, which is well worthy of attention. It will be remembered that not long ago Professor Huxley wrote an able article in that magazine on "Technical Instruction," and the one now before us comes as a useful supplement on this very important subject. Lord Armstrong speaks with authority as one of the largest employers of skilled labour in this country, and as one who has established successfully immense works, whose reputation is second to none in dealing with the practical application of science to the requirements of modern warfare. We have therefore the views of a writer well able to judge of the need for technical instruction. Let us see what he has to say on the subject.

In the first place Lord Armstrong complains that at the present time there is a general outcry for technical education, although few people have any distinct idea of what they mean when they use that term, or any definite opinion either as to the class of persons who will be chiefly benefited by it, or as to the time of life at which it ought to be acquired. We cannot help feeling that there is much truth in these remarks, and we go further and say that the vague and indefinite speeches often made in public on technical education do more harm than good. They show to manufacturers and others who have the responsible conduct of works where technical skill is required, that the speakers are often mere *dilettanti*, having but very slight knowledge, if any, of the true bearings of the subject they profess to understand. To put it plainly, this rather disgusts the well informed, and if it does not lead them to pooh-pooh all that is said, it at least begets a feeling of distrust, and they often stand aloof. The practical result is that discussions usually are too diffuse and wanting in thoroughness. It is all very well to give expression to admirable generalities, but to be useful they must be accompanied by definite conclusions in detail, based on actual knowledge. Before dealing with technical instruction, Lord Armstrong comments on the present system of primary or elementary education, and he gives it as his opinion that it has the radical defect of aiming at instruction in knowledge rather than the training of the faculties. It will be remembered that Professor Huxley also thinks the present system of elementary education too bookish, and the opinion that this is so is becoming more general. Far be it from us to depreciate the value of knowledge —knowledge is power—but it must be limited, and of a suitable kind for the young mind, and have some relation to the work by which the student must afterwards earn his or her living. Lord Armstrong rightly points out that a man's success in life depends much more upon his capacities for useful action than upon his acquirements in knowledge, and he objects to the memory of a child being burdened with facts, rules and information which for the most part are of little use for developing the intellect, or preparing it for the ordinary vocation of life. He adds that not only should the mind be trained in habits of thought, and in quickness and accuracy of perception, but that the hand, the eye, and the ear should all participate in training exercises. He recommends the teaching of drawing, as well as exercises for cultivating the mobility of the hand, with precision and delicacy of touch. If in so doing the ability to use simple tools were acquired, it would be advantageous in any line of life that might be ultimately adopted. Every man and woman would be the better for pre-acquired manual dexterity, but to attempt to teach children special trades and processes of manufacture would, he conceives, be a mistake, and in this we entirely agree. It would involve great expense, would be a misapplication of time, and would only forestall the more effectual teaching, which at a more suitable age may be obtained by actual practice in factories and workshops. He aptly remarks that if a juvenile pickpocket can be trained to use his hands with exquisite adroitness in the practice of his nefarious occupations, why should not the hands of a schoolboy acquire by proper training similar mobility and delicacy of touch, to be used for honest purposes? The cultivation of the power of observation he also considers of great importance, and he reminds us that Houdin, the celebrated conjuror, and his son practised the receptive power of their eyes by walking quickly past shop-windows, and then recounting all the objects which in the moment of time had been presented to their view. Coming more closely to the subject of this article, Lord Armstrong says that most people have the mistaken notion that technical education is especially required for the working classes. He is of the opposite opinion, and points out that in the numerous class of labourers figuratively styled hewers of wood and drawers of water, no man would be rendered more efficient by the possession of any kind of technical knowledge, although the value of his labour would undoubtedly be enhanced by his having been, as a boy, trained in the exercise of his hands and limbs. In a higher scale of labour he takes the case of artificers, such as joiners, carpenters, fitters, and all others who work in wood and iron for constructive purposes. Here again he finds that manual skill, intelligently used, is the chief criterion of the value of their labour. These men, in general, work under direction, and so long as they do so it is their manual skill, and not their knowledge, that comes into play. He concludes, therefore, that knowledge, distinct from manual skill, does not add to the value of their labour. In the case of foremen, and others who emerge from the class of manual workers, he thinks that a certain amount of technical knowledge is useful, but considers that all the formation they require, can be found in a condensed and tabulated form in handbooks applicable to all kinds of constructive art. He then considers the class of managers and designers, who require technical education in a higher degree; but even here he thinks it is only in rare instances that high attainments in science are essential to practical results. Without doubt there is much truth in these statements, but we cannot help feeling that they need some qualification. We think Lord Armstrong is right in saying that technical instruction will not improve the work of labourers. At the last meeting of the British Association it was urged seriously that farm labourers would be better able to do their work if they learnt the science of successful husbandry; but such an idea is Utopian. By all means let the children of the working classes seek the best instruction obtainable, but do not let any one of them be misled by supposing that he has mastered the science of his calling, when in truth he can have but a parrot-like acquaintance with it. Lord Armstrong may also be right in supposing that joiners and mechanics will not be benefited by technical instruction, but we cannot agree with him that there is little or no need of it on the part of those who superintend the work of labourers and artificers. The need for this will vary somewhat in different trades, but in all we think it most desirable that the masters, the managers, and the leading foremen should have a technical training, which will not only fit them to direct and improve the work done under them, but enable them to understand and appreciate new or improved methods of attaining the ends required which may be brought to their notice. As we once before took occasion to remark, this is the crux of the whole question, and it is because our managers and superintendents have so neglected this part of their training, that the better trained foreigners have in many instances overtaken them. If the foremen, or heads of departments, are to be merely improved or extra-skilled labourers, or artificers, as Lord Armstrong leads us to suppose, it cannot be expected that they will benefit much from technical education. We trust, however, that the time will come when it will be necessary for those who are to take charge of workshops and factories to have learnt the science of their work, *i.e.* (to borrow Mr. G. J. H. Lewes's admirable definition) the systematic classification of experience, as well as the mere manupulative skill. At the present time, in Germany, superintendents often know more of the theory than of the practice of their work, but this, of course, is going to the other extreme. We only ask for a fair proportion of both theory and practice. Lord Armstrong has no faith in saving our commerce from the effects of foreign competition by a wide diffusion of technical knowledge. He thinks that cheapness of production and superiority of quality will decide the victory in the race of competition. This we think also, and we also agree with him that we shall improve our chance of maintaining a foremost place by the development of the mental and bodily faculties of our workpeople. At the same time we must remember that cheapness of production and superiority of quality will largely depend on the supervision of the works being in charge of persons who have received a good theoretical and practical training.

Reviews.

The Book of Bee-keeping; a Practical and Complete Manual on the Proper Management of Bees. By W. B. Webster, First-class Expert, B.B.K.A. London: L. Upcott Gill.

We well remember inspecting with no small pleasure the exhibits of the British Bee Keepers' Association at the "Healtheries." We were then strongly impressed with the conviction that bee-keeping, or, as it is now more learnedly called, "apiculture," might be carried on to a much greater extent in this country than it has yet ever been. In all rural, and even surburban districts, there must be multitudes of flowers which are never made to yield their tribute of nectar to any hive. We are, therefore, much pleased at the appearance of the volume before us, written specially, as the preface tells us, for amateurs, beginners, cottagers, and others who are desirous of keeping two or three hives of bees. Mr. Webster writes so simply and plainly, and from so evidently practical a point of view, as to be intelligible to all.

The profits of bee-keeping, when conducted in an intelligent manner, are shown to be much greater than an unobservant person would imagine. The author mentions two cases of working men who in this way cleared £29 and £25 in one season. We are glad to learn that, in addition to the supply of honey and wax, the value of bees is beginning to be recognised by gardeners and fruit-growers as promoting the fecundation of blossoms, and consequently increasing the crop. Says the author: "A widow woman in Hertfordshire, who depended in a great measure upon her cherry orchard for a subsistence, was obliged to obtain a fresh supply of bees after she had sold her original hives, as her orchard was not nearly so productive; this quickly righted itself after the introduction of the bees. Such facts speak for themselves." Most lovers of nature, though they may never have had any experience in apiculture, regard the mellow hum of bees over the garden beds as quite one of the enjoyable features of a summer day. The fear of being stung is very needless, unless we go out of our way to disturb a hive. It must, however, be remarked that some persons give off a specific odour imperceptible to our duller senses, which the bees recognise and resent. The nicety of smell and taste in bees is remarkable. Eminent chemists—the wish being, perhaps, father to the thought—tell us that beet-sugar and cane-sugar are the same thing. The little bee knows better. She will not touch the beet-product if any of the genuine tropical article be within reach. It is much to be regretted that tons of spurious honey, consisting of glucose, manufactured by the action of sulphuric acid upon potatoes or maize, have long been imported into England, and have done no little towards bringing honey into disrepute.

Of the different varieties of bees the author recommends the Ligurian strain. In productiveness they beat the common black bee by quite 25 per cent., and in addition they beat off robber insects in a more systematic manner. The Cyprian is said to be an excellent honey gatherer, but extremely irritable.

Beginners are advised to read some plain modern treatise on bee-keeping, and inspect some of the exhibits of bees to be seen at horticultural shows. The hive purchased should be one with the standard Association frames, which are all easily interchangeable. The stock purchased should be pure Ligurians.

In describing the method of hiving a swarm, the author declares that the old style of beating a "tom-tom" on pots, frying pans, and kettles, may amuse the beaters—it is a duty for which boys always readily volunteer—but it has no effect upon the bees.

The reader will find, in short, that every point in the practice of bee-keeping is very clearly explained. We may recommend this little manual to all intending bee-keepers, and we hope it may induce many persons who live in suitable places to try what they can do in apiculture.

The Land of the Broads. A Practical and Illustrated Guide to the Extensive but Little-known District of the Broads of Norfolk and Suffolk. By Ernest R. Suffling. London: L. Upcott Gill.

A pleasant, open-air book, fraught with the imageries of woodland and stream and open fields and skies innocent of smoke! It would, of course, have been more to our taste had the author been a naturalist, able to tell us something more about the fauna and flora of the district. He writes, indeed: "To the entomologist, ornithologist, and botanist I would say, By all means take your holiday here, for you may bring back with you specimens wherewith to beguile many a long winter's evening with your favourite pursuit. For butterflies, birds, and plants, this is a perfect El Dorado."

The book is rich in scraps of archæology, architecture and folklore, notes on the architecture prevailing in the region, and specimens of the curious local dialect. That he has a keen eye for the picturesque and an appreciation at once of the beautiful and the humorous, the reader will soon recognise. It is painful, however, to find that Mr. Suffling has to put in his protest against the practice of setting up empty bottles in the fields as "cockshies," and leaving the broken glass scattered about, to the danger of cattle and horses.

The author mentions the Norfolk coasts as localities where the palæontologist sometimes finds treasures, especially after a strong north-westerly gale.

Due mention is made of the museum at Norwich, eminently rich in raptorial birds and in fossil bones. Incidentally the author speaks of the "Madder Market." This makes us wish that he, as a native of Norfolk and evidently well acquainted with the history and traditions of his native county, had told us whether madder was formerly cultivated on an industrial scale in the eastern counties.

The changes which the River Yare has undergone since the days of King Canute are duly chronicled. It seems strange, though established beyond doubt, that Norwich was once a fishing-town. But other East Anglian rivers have fared like the Yare. It is said that all the stone for building the Abbey of St. Edmund's was brought by sea from Caen, and conveyed up the Orwell and the Gipping, past Stowmarket, and to within a few miles of its destination. Now the tide does not ascend beyond Ipswich.

The account of the kingfisher—a bird doomed, we fear, to early extirpation—is open to misunderstanding. The author doubtless knows that not merely one species of this bird, but many are found in tropical and subtropical countries, though none surpass the native kingfisher in beauty.

The author is perfectly correct in affirming that herons are capable of swimming and diving, and we should scarcely have thought that the contrary opinion was still held by any naturalist. Waterton maintains that these dignified birds neither swim nor dive, but his friend and biographer, Norman Moore, has seen them doing both in the lake at Walton Hall.

We find here a notice of some curious superstitions. The writer, however, does not mention two of the most curious which exist in Suffolk, and doubtless extend into the sister county. One of these is the notion that stones—paving-stones, mile-stones, boulders, etc.—grow if left lying on the ground. The other is the faith in the practice of hoplochrysm. If a labourer cuts himself with sickle, bill-hook, or knife, he simply binds up the wound and applies some medicament to the tool or implement which has caused the injury. This is a venerable superstition, and was in former ages recommended by Helmont and practised by the most eminent surgeons. That such delusions will sooner or later fade away is very probable, but it is to be feared that their place in the popular brain may be taken by follies as illogical and more dangerous. Mr. Suffling's book may be safely adopted as a guide by pleasure-seekers bound for the "Broads," and we believe that in seeking a place for their holiday excursions they might go further and fare much worse. We must not overlook one pleasant feature of the work before us—the author is not troubled with "views," or, if he is, he does not feel bound to obtrude them upon his readers.

Henslow's Botany for Beginners. A short course of elementary instruction in practical botany for junior classes and children. By the Rev. Professor G. Henslow, M.A., F.L.S., F.G.S. Fourth edition. London: E. Stanford.

We are not in the least surprised to find that a fourth edition of this excellent little manual has been required. In our judgment it is a model of a scientific treatise for beginners. The course of instruction from the very first is practical, not wordy, but *thingy*, if we may so call it. If this book is used according to the principles laid down in the preface, the pupil will be gradually trained to observe closely and correctly. This, we submit, much more than the mere facts recognised, is the true point to be aimed at in teaching any of the natural and physical sciences.

The author takes up in succession a number of common British wild plants—easily procurable in most country places—and by their means expounds the leading principles of botany. By the time a boy or girl of ten to twelve years of age has worked through this series, he or she, except of unusually narrow capacity, will have "eyes" in place of the "no eyes," now so alarmingly common. At the same time the pupil obtains a living, a hand-to-hand familiarity with the technical language of botany, and can henceforth read botanical works with understanding and profit.

We notice with pleasure that the author gives instances of fruitful hybrids, thus fortifying the pupil against one of the favourite fallacies of the opponents of evolution.

A Catalogue of the Moths of India. Compiled by E. C. Cotes, First Assistant to the Superintendent, Indian Museum, and Colonel C. Swinhoe, F.L.S., F.E.S., F.Z.S., etc. Part II. *Bombyces.* Calcutta: Trustees of the Indian Museum.

This division of the author's work comprises no fewer than 1,623 species, including, of course, the important silk-yielding genera *Bombyx*, *Attacus*, *Saturnia*, and *Antheræa.*

The *Bombyces* are here divided into the families *Aegeriidæ*, *Zygænidæ*, *Agaristidæ*, *Chalcosiidæ*, *Nyctemeridæ*, *Lithosiidæ*, *Arctiidæ*, *Liparidæ*, *Bombycidæ*, *Notodontidæ*, *Drepanulidæ*, *Limacodidæ*, *Lasiocampidæ*, *Phaleridæ*, *Sa urnidæ*, *Cossidæ*, and *Hepialidæ.*

As in Part I. of the "Catalogue," the synonymy of each species, if needful, is given, and there is reference to collections where the type is to be seen.

The *Bombyces*, owing to their comparatively feeble powers of flight, show a much less tendency to become cosmopolitan than do the *Sphinges.* Families and genera are often common to India and to Europe, but we do not recognise a single species except it has been artificially acclimatised. Not a few of the species here described were ranked by Linnæus, Cramer, etc., among the *Sphinges.*

Archæological Discovery at Chester.—A curious line of massive blocks of sandstone have been recently unearthed in Foregate-street, extending for nearly one hundred yards in a line with the present street, and four feet in depth. No definite conclusion has been arrived at respecting the stones or their age.

Abstracts of Papers, Lectures, etc.

MINERALOGICAL SOCIETY OF GREAT BRITAIN.

A GENERAL meeting of this Society was held on June 28th, at the Museum of Science and Art, Edinburgh. Professor Geikie occupied the chair. "The Distribution and Origin of the Mineral Albertite in Ross-shire" formed the subject of the paper by Mr. Hugh Miller, F.R.S.E., H.M. Geological Survey. The conclusions he arrived at were that the primary source of the albertite in the Strathpeffer district was the bituminous shales of the old red sandstone; that the mineral, although it occurred in gneiss, in sandstone, in conglomerate, and in the bituminous shales themselves, was found mainly in the vicinity of faults, where the strata had been subjected to great pressure; that the veins are, in some cases at least, injection veins, having some of the characters when studied in detail of intrusive dykes; that the veins, having very seldom the same direction as the lines of fault or the fault-joints parallel with these, probably were injected into lines along which there was relaxation of pressure; and that the mineral, in those instances which can best be studied, entered the veins in a fluid and penetrating form, probably in the form of some kind of petroleum. A paper, accompanied by a series of tables, was next submitted by Messrs. Alexander Johnstone, F.G.S., and A. B. Griffiths, Ph.D., F.R.S.E., on "The Rock-forming Feldspars and their Determination." Papers were also submitted by Professor Albert H. Chester, Hamilton College, U.S.A.; the Rev. W. W. Peyton, William Morrison, M.A., Dingwall; and Professor M. F. Heddle. A series of hydro-carbons were exhibited by Professor W. Ivison Macadam, and an analysis given of the albertite beds; some fine crystals were shown by Mr. S. Peyton and Dr. T. A. G. Balfour; a series of minerals from Iona and Tiree were sent for exhibition by the Duke of Argyll.

ROYAL HORTICULTURAL SOCIETY.

AT the meeting of the Scientific Committee, on June 26th, Professor Church contributed a summary of his highly interesting and important researches upon the presence of aluminium in the ashes of plants. This substance, instead of being peculiar to the species of Lycopodium, as once supposed, is found in minute traces in the ashes of very many others, a circumstance not to be wondered at, considering the abundant distribution of the element in many soils. It occurs in all the species of Lycopodium examined, except those which are of epiphytic habit, and which, consequently, do not directly derive their food from the soil. It does not occur in the allied genus Selaginella. It occurs in the ashes of some tree ferns in large proportions, sometimes forming as much as 20 per cent. of the ash, as in *Alsophila australis*, *Cyathea medullaris*; while from others it is all but absent. In the British species of ferns little or no alumina has been found.

Mr. McLachlan showed specimens sent from Trinidad of beetles injurious to tobacco and egg plants in that island, and which he found to be a species of Epitrix, allied to that which feeds on *Atropa belladonna* in this country.

Mr. McLachlan called attention to the notion that cold winters are injurious to insects—a notion he stated to be erroneous, although, no doubt, severe alternations of cold, heat, drought, or moisture, were prejudicial to insect life. During the present season it was noticed generally that great destruction of foliage occurred from caterpillars, which destroyed the succulent portions of the leaf and tied the frame-work and fragments together by a web of fine threads comparable with spiders' webs. These caterpillars were different in different cases. In the oak they were species of Tortrix; in the apple the winter moth was destructive; while in other cases the larva of the Ermine moth was exceedingly hurtful to leaves.

Mr. Plowright, in a note, stated that the Æcidium on pea and on the bean was produced on both plants by infecting them with the same infecting material, viz., *Uromyces fabæ*. The Æcidium on the pea differs in appearance from that on the bean, the pseudoperidia in the former being few, and scattered over pale yellowish spots, while on the bean they are crowded in thickened white spots.

THE SANITARY INSTITUTE.

AT the twelfth annual meeting of the members of this Institute, held on July 12th, in the Lecture Hall of the Royal Institution, Mr. E. Chadwick, C.B., in the chair, Mr. B. W. Richardson, M.D., read a paper on "Storage of Life as a Sanitary Study." After referring to instances of long life in lower animals and in man, he said these animals and these persons by some peculiar process as yet but little investigated held life as a long possession, and to this faculty he applied the term "storage of life." The conditions which favoured such storage he held to be (1) hereditary qualification, (2) the virtue of continency, (3) maintenance of balance of bodily functions, (4) perfect temperance, (5) purity from implanted or acquired diseases. Speaking first on the influence of heredity, he remarked that if the ages at death from natural causes were obtainable of the parents of a man or woman through three generations, the sum total of them divided by six might be accepted as the commercial value of the last life. Bilious and sanguine temperaments were the best for a long life, and the nervous and the lymphatic the worst. Treating on the virtue of continency, he maintained that under a proper sanitary and healthy régime there would be no danger of, nor trouble from, over-population. In the third division of his discourse he held that a body comparatively weak, but with all the organic structures of good balance, was calculated to live longer than a finer body with one of its organs enfeebled or diseased. Coming next to temperance, he maintained that all luxuries are bad for long life, that stimulants of every kind are detrimental, and alcoholic stimulants the most so. The prevention of disease was the last topic dealt with, and here it was, he said, that the art of sanitation came into most effective play.

LIVERPOOL ASTRONOMICAL SOCIETY.

THE annual meeting was held at Liverpool on Monday July 9th, when the report of the Council was read. The Society appears to have made very satisfactory progress during the year. The number of members has been increased by more than 200, and the balance-sheet shows that, in a pecuniary sense, the Society occupies a favourable position. Considerable additions have been made to the library during the past year, and the work of the different sections has been of a very varied and extensive character.

Mr. T. G. E. Elger, who is well known in connection with selenographical work, was elected President for the ensuing year, in succession to Mr. W. F. Denning, of Bristol, whose valuable labours in meteoric and planetary astronomy have long been recognised. The report of the Council included a reference to the resignation of the Hon. Sec., Mr. W. H. Davies, and expressed a gratifying tribute to his zeal and assiduity in performing the arduous duties of his office for such a long period. His energy and capacity for management has contributed, more than any other cause, to the rapid development of the Society, and to the high position which it has attained amid kindred associations. Mr. Davies is succeeded by Mr. W. E. Rowlands, and there is every prospect that the future of the Society will be conducted on an equally satisfactory base as in the past. There can be no doubt that it is accomplishing a most useful purpose in banding together and utilising the work of our astronomical amateurs. The *Journal*, which is published monthly during the sessional meetings from October to May, is widely read, and contains papers on various branches of the science by writers who are entitled to speak with authority. The possessors of telescopes, and all those who may either feel interested in astronomical theories or in practical work, must naturally regard this Society with sympathy and accord it their support, as especially calculated to encourage and stimulate their efforts in learning something more of the wonders of the heavens.

Manchester Scientific Students' Association.—On June 16th the members of this Association made an excursion to Chelford for Capesthorn, under the leadership of Mr. J. Hetherington. Owing to an unfortunate delay, Mr. Hyde's botanical lecture on "Umbelliferæ" had to be delivered in the train. On June 30th a visit was paid to the Manchester Ship Canal's Works at Eastham, and the newly-discovered old footpath or road inspected.

Barrow Naturalists' Field Club.—The first excursion of the season was made on June 30th to Ravenglass, where the ruins of Wall's Castle were inspected. A visit was then paid to Ross Camp, on Muncaster Fell.

Ludlow Natural History Society.—The annual report of this Society has just been issued, and we regret to find that the Society has been compelled to draw upon its reserve fund. We trust the appeal to the residents will be successful.

Manchester Microscopical Society.—At the concluding meeting, for the present session, of the mounting section, the chairman, Mr. E. P. Quinn, in the course of a description of nearly 100 slides exhibited by him, said that they had been specially mounted to use that evening to illustrate the micro-chemistry and physics of the vegetable cell. As he desired to show them the cells in a condition as nearly as possible like that of the fresh tissues, he had mounted the specimens mostly in fluid media and principally in a 0·4 per cent. solution of sodium fluo-silicate, which, whilst having the preservative effects of solutions of corrosive sublimate or carbolic acid, did not, like them, tend to take away the green colour which was in many cases so desirable to preserve. Another advantage in using it is that it causes but little alteration in the shape of the cells, owing to its slight solubility (four parts in one hundred) in water. It is sold as a disinfectant under the name of Salufer.

POISONS AND POISONING.

A Lecture delivered by C. Meymott Tidy, Esq., M.B., etc., before the Royal Institution of Great Britain.

(*Concluded from p. 46.*)

THERE naturally follows on what I have said respecting this chemical action of poisons, the following important question :—

Given knowledge of certain properties of the elements, such as their atomic weights, their relative position according to the periodic law, their spectroscopic characters, etc. ;—or given knowledge of the chemical composition, the molecular constitution, together with the general chemical and physical properties of compounds, in other words, given such knowledge of the element or compound as may be learnt in a laboratory—does such knowledge afford any clue whereby we may predicate the probable action of the element or of the compound respectively, on the living body ?

1st. Let us limit our attention to the *elements*.

The starting-point of this inquiry was the toxic properties of the metals. The work of Blake (1841) in this direction was afterwards extended by Rabuteau (1867). Their observations led them to the general conclusion that "the physiological activity of the metals increased with their atomic weight." This broad general statement was modified at a later period by noting that the reverse was the case with certain groups of metals. Thus potassium (39) is more poisonous than sodium (23), and barium (137 more poisonous than calcium (41). These facts led Rabuteau to the conclusion that any comparisons of toxicity must be limited to the metals belonging to the same group. Husemann and Richet, however, pointed out that even this rule did not hold good, seeing that lithium having an atomic weight of 7, was far more poisonous than either sodium or potassium.

Experiments on the metals were further conducted by Richet with the metallic chlorides. Grain by grain, at intervals of forty-eight hours, he added the chlorides to water in which he kept fish of a given kind. He then recorded the maximum strength of the solution of the metallic chloride in which these said fish would live for forty-eight hours. The conclusion at which he arrived was that the limits of the toxicity of a metal bore no relationship either to its atomic weight, or to any other chemical or physical characteristic of the metal.

Bouchardat and Stewart Cooper, in a similar manner, experimented with the non-metals. Selecting the haloid group of elements, they noted that their toxicity was inversely to their atomic weight, flourine (19) being the most poisonous, and iodine (127) the least poisonous of the group, chlorine (35.5) and bromine (80) occupying their proper intermediate positions. But here again the group theory was inevitable. What was true of monad elements was not true of the elements of higher atomicity, the toxicity of selenium (79) being far greater than that of sulphur (32).

With these facts before us there arises this question, Was a relationship to be expected between physiological action and atomic weight ? One poison acts on muscles, a second on nerves and nerve-centres, a third on the blood :—Is it likely, even supposing a relationship to exist between a certain group of elements and a given organ or a given structure, that the relationship would be the same in the case of all organs and all structures ? These researches (the outline of which I have briefly indicated) suggest this much to future observers, viz.: First of all group your poisons according to their methods of operation, and then see how far the degree of toxicity of the terms of any one group show relationship to the atomic weights of such group.

But the difficulties of comparison thicken when we consider the physiological action of certain allotropic modifications of the elements.

Thus compare *yellow* phosphorus, a body readily inflammable, soluble in bisulphide of carbon, firing by contact with iodine, with *red* phosphorus, a body at variance with the yellow variety in the three respects named. Nor is this all. For *yellow* phosphorus is an active poison, two grains being a certainly toxic dose, whilst *red* phosphorus is an absolutely inert body.

Take a second illustration. In its ordinary form oxygen plays the part of a life sustainer. But oxygen is only a life sustainer in its common form and at ordinary pressure.

On this latter point I have no time to dwell, save to mention that if an animal be exposed to oxygen at three pressures, the resulting symptoms are not unlike those induced by strychnine.

There is, however, an allotropic form of oxygen called *ozone*. The physiological action of ozone was the subject of a communication to the Royal Society of Edinburgh by Dewar and McKendrick (1873). Their experiments were made on both cold and warm-blooded animals, including amongst the latter themselves and their assistants.

The results are remarkable, more particularly when we remember that the air with which they operated, at most only contained 10 per cent. of ozone.

Placing a large frog in a jar of air, and then ozonising the air, the frog in about half a minute closed its eyes, the respirations fell from 96 to 8 per minute, and the body temperature was lowered 4° or 5° C. The animal recovered in about 8 minutes, when pure air was admitted into the receiver. Death resulted if the animal was exposed for any lengthened period to the action of the ozonised air.

As regards the action of ozone on warm-blooded animals, Dewar records certain personal experiences, chief amongst which were a tendency to breathe slowly, an enfeebled pulse, and fits of sneezing.

But now comes the curious part of the story, viz. that at the *post-mortem* on the animals that died under the influence of ozone, the blood was found to be *venous*. (The results were similar when pure ozonised oxygen was employed.) It is most remarkable that the *post-mortem* appearances of death from an intensified oxygen should resemble those of death from carbonic acid.

I give these illustrations to show why there should be reason to doubt whether the physical or chemical properties of an element can ever suggest either toxic activity or physiological action.

2nd. *Compounds*.

Is there any relationship between the chemical composition or constitution of a compound body and its physiological action?

The first series of researches on this question was directed to determining whether, in the case of a salt, the acid or the base was, physiologically, the most important ingredient (Blake 1841).

No doubt most often the active agent of a salt is the base, but this is by no means uniformly the case. Probably the solubility of a compound and the different proportions of acid to base in the salt (*i.e.* whether the compound in question be an acid or a basic salt) are agencies which also help to determine the toxicity of the body and its physiological action.

A second series of experiments was made by Blake for the purpose of showing that, given a series of isomorphic salts, the intensity of physiological action increased with the molecular weight. He further contended that salts crystallising in different forms had different physiological actions. On this basis he constructed a series of nine groups of salts, each group being characterised by special physiological actions, insisting with much reason that we possess in living matter a reagent (so to speak) capable of aiding us in our investigations into the molecular properties of chemical compounds. If from molecular constitution you can determine physiological action, probably from physiological action conversely you may determine molecular constitution.

Another series of experiments in a similar direction were made by Schoff on the Continent, and by Fraser and Crum Brown in this country.

Of these experiments the most important are those indicating how from bodies of vastly different physiological action you may obtain derivatives having similar properties.

For example, the physiological action of *strychnine* is primarily exerted on the spinal cord. As a result, convulsions occur as a prominent symptom. But if we introduce into the strychnine molecule a methyl group (forming methyl-strychnine), the action of the drug is altered—methyl-strychnine paralysing (strychnine stimulating) the motor nerves.

But here comes a curious fact. If we take morphine, or nicotine, or atropine, or quinine, or veratrine (none of which bodies are comparable in their physiological action to strychnine), and convert them into their methyl-derivatives, the methyl compounds formed (viz. methyl-morphine, methyl-nicotine, etc.) are comparable in their physiological action to methyl-strychnine.

We must admit these experiments to be striking. One treasures any experiment suggestive of the chemical constitution of a body indicating physiological action.

But again :—The true physiological action of a drug is not so much its general as its selective action, this selective action being largely dependent on the *dose* administered and the mode of administration.

For example: Inject into the circulation of a frog a *small* dose of *veratrine*, great muscular stiffness results, a *large* dose similarly administered not producing this effect. And now change the method of administration: Apply the *small* dose directly to the muscle, you get no symptom; but apply the *large* dose directly, and great muscular stiffness results. Here see the modifying influence of dose and of the mode of administration.

Again, the difficulty of "allotropism" in the case of elements, finds its counterpart in "isomerism" in the case of compounds. Thus cyanogen and paracyanogen are bodies of identical *percentage* composition, and yet cyanogen is one of the most poisonous of gases, whilst paracyanogen is one of the most inert of solids.

Or, again, take *piperin* and *morphine*. These bodies are of identical percentage and molecular composition. They agree (it is true) in being poisons. But how vastly different their physiological action!—the one an extreme irritant, the other a powerful narcotic.

I fear we must admit that, as no *a priori* reasoning could predict that by combining copper and sulphuric acid a blue salt would be formed, so no *a priori* reasoning, no knowledge of chemical constitution, can predicate what will be the special organ on which any given poison will act, nor, even supposing that the organ upon which the chemical activity of the drug will be exerted be known, what will be the nature of such chemical action. The science of drugs, like the science of chemistry, is, and must ever remain, an experimental science.

And, be it remembered, the poisons of the toxicologist are the medicines of the physician. Physiological action is a subject-matter for experiment. Let the guard be jealously set and as rigidly maintained to prevent cruelty to animals; but ask yourselves, whether to rob the higher creation of life and health rather than that one of the lower creation should suffer, be not a refinement of cruelty—the cruelty of cruelties?

Two general observations are suggested. And this first: The later age history of poisoning is the history of a profession. This profession we find closely associated, not only with the profession of medicine (the art of healing), but with witchcraft, incantation, and charms. The threefold arts of poisoning, witchcraft, and medicine, moreover, become so closely allied to religion, as to claim, each and all, the shield of a sacred sanction and the protection of a Divine voice. Even that very word *φάρμακις*, the Greek for '*a dispenser of medicines*,' is the same word used to imply '*a witch*' and '*a poisoner*.' The modern scientist has once and for ever shattered the bond that united science with superstition. It was a special ministry of science to teach men that in the preparation of medicines the pharmacist required no stuffed crocodile to preside over the mysteries of his laboratory, nor incantation to give virtue to his drugs.

And this secondly: The villanies of the early poisoners can never again be practised in the light of the science of the nineteenth century. Science can and has done what legislation could never do. I claim that a science which, like a blood-hound, can track with cunning scent the minutest atom of a poison in the body, *is* helping forward the day when poison shall cease to be the instrument of a secret treachery, because there are eyes it cannot hope to evade, and a science whose investigations it will not dare to defy.

Insect Powders.—These powders, according to a communication from M. de Tartaglia to the *Echo Universel*, are made from the pyrethrum of the Caucasus, which grows spontaneously in Dalmatia and Albania, and is now the subject of an extensive and lucrative commerce. The plant loves light, calcareous soils, free from damp. The planting is effected in spring and autumn, preserving a distance of two feet between the plants, and carefully removing weeds. The produce for the first year is insignificant; the second year it repays all expenses, and the third year the plants are covered with flowers. The crop from $2\frac{1}{2}$ acres of ground is 10 cwt., and is worth at present about £200 per cwt. Why is its cultivation not attempted in Australia or at the Cape?

Sulphonal, the new Soporific.—This newly-discovered compound, though itself free from smell or taste, is manufactured from mercaptan, one of the most malodorous products known. According to the *Medical Press*, the manufacturers of sulphonal have, in consequence, some difficulty in finding a place where they may carry on their business without the risk of proceedings for creating a nuisance.

THE GROWTH OF CHILDREN.

Until recently it was supposed that the growth of children, and in an analogous manner, of other young mammalian animals was a perfectly continuous process. Accurate measurements and weighings have shown, however, that such is by no means the case, and that, on the contrary, human growth takes place in certain periods, with intervening times of cessation.

Some interesting data have been recently collected by Malling-Hansen, Principal of and Chaplain to the Royal Institution for Deaf-Mutes at Copenhagen, and have been communicated to *Humboldt* by Prof. Gadd.

In this establishment, 130 children—boys and girls—have been daily weighed and measured since the beginning of the year 1884.

In the weights three main yearly periods of increase may be distinguished—a maximum, a mean, and a minimum. The maximum period begins in August and ends in the middle of December, lasting four and a-half months. The mean period lasts from the middle of December to the end of April, four and a-half months. The minimum period extends from the end of April to the end of July, three months. During the maximum period, the daily increase of weight is three times as great as in the mean period, and almost all that is gained in this mean period is lost again in the minimum period.

The increase in height likewise exhibits three main periods, a minimum, a mean, and a maximum. The minimum period begins at Copenhagen in August, and lasts until about the end of November, about three and a-half months. The mean period extends about four months, from the end of November to the end of March. The maximum period lasts from the end of March to the middle of August, four and a-half months.

In the mean period the daily increase in height is twice as great, and that in the maximum period two and a-half times as much as in the minimum.

The true period of growth, if we take both height and weight into account, extends from the end of March into December, and may be divided into two parts; firstly, the maximum increase of height, and then the maximum growth in weight.

During the latter period, the growth in height is so trifling that it may be regarded as a pause in growth.

The mean periods of increase both in height and weight coincide for the greater part of their duration, but the growth in height is during this period relatively more considerable than the gain in weight.

In like manner the minimum period for weight and the maximum for stature are chiefly coincident. The maximum period of growth is the pause of gain in weight, and is even attended with a loss in this respect.

The periods of height begin and close about a fortnight earlier than the weight-periods.

The periods of stature follow in an inverse order from the weight-period. The development of stature rises gradually from the minimum through the mean to the maximum, and sinks then suddenly to the minimum. The increase of weight rises at once from the minimum to the maximum, and sinks them slowly through the mean period down to the minimum.

The fluctuations of the periods of weight are much more considerable than those of the height periods.

One centimetre (3-8th inch) in height corresponds in the maximum weight period to an increase of 6 lbs. 3 ozs. (?) in the mean period to 16 ozs., and in the minimum period to 17 ozs.

It has doubtless not escaped the observation of attentive parents, that the growth of their children in height appeared to be approximately in an inverse proportion to their increase in weight. But the precise observations of Malling-Hansen have not merely established this point, but have brought it into relation with the seasons of the year.

But it is obvious that very much remains to be done in this by-way of biology. Malling-Hansen's observations were made upon children of both sexes between the ages of nine and fifteen. It is now necessary to inquire whether the same periods of increase in height and weight can be traced from the fifteenth year to the attainment of full maturity. Another point is the extension of the observations to children of other races and in other climates. Malling-Hansen has already surmised a connection between the intensity of growth of children—and of course of all organisms—and the variations in the heat radiated by the sun upon the earth. He does not suspect that the fluctuations in the totality of heat derived from the sun are the direct, immediate cause of the variations in the increase of weight, but he, with Boys-Ballot, thinks it probable that an unknown agent proceeds from the sun in periods corresponding to the solar rotation of twenty-seven days. This unknown agent he supposes to arrive unconnected with meteorological conditions. Its sphere of action, he thinks, includes all organisms which, according to the time of the year, are differently susceptible to the stimulus of this "growth-energy."

In the meantime he points out in particular one among the many practical conclusions to which his observations may lead. As much as possible of the two periods of maximum growth—*i e.*, in height and weight—should be passed in the summer holidays. In this respect the Swedes and the South Germans have, by instinct or accident, outstripped the North Germans and the Danes. The former give their children two entire months of holiday in the summer; in some parts even more. Some schools in the west of Germany, we must remark, give no holidays at all.

The summer holidays should begin at the end of June and extend to the beginning of September, thus allowing full play for the maximum periods of growth.

Besides the above-mentioned three annual phases, Malling-Hansen has recognised periods of 25 and of 75 days within which the conditions of growth undergo cyclical variations.

As regards the daily fluctuations, he finds that on the average of the three months, December 1883, and January and February 1884, every boy in the institution lost about ½oz. in weight between the conclusion of dinner, at two p.m. to nine p.m., and in the course of the night, from nine p.m. to six a.m., a further amount of about 2ozs. From six a.m. to one p.m., just before dinner, each boy regained nearly ½oz. Whilst the dinner effected in each an average increase of 2⅜oz.

The following changes of height were observed in 22 boys, varying from 13 to 16 years, during five weeks. From 6 to 8 a.m. there was a loss of 4 millimetres; during lessons, 8 to 9 a.m., a gain of 3 millimetres; from 9 to 10 a loss of 1 millimetre. From 10 to 11 (play-time), a further loss of 1 millimetre. Between 11 and 12 a.m. (lessons), a gain of 2 millimetres; from 12 to 1 p.m., a loss of 4 millimetres; and from 1 to 5 p.m., of 3 millimetres. Thus from 6 a.m. to 5 p.m. there was a nett loss of 9 millimetres in height (nearly two-thirds of an inch). From 5 to 9 p.m. the changes were trifling, and from 9 p.m. to 6 a.m. there was a gain of 9 millimetres.

CORRESPONDENCE.

The Editor does not hold himself responsible for opinions expressed by his correspondents, nor can he take notice of anonymous communications. All letters must be accompanied by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

A CIRCLE PROBLEM.

Your correspondent, "A. P. T.," has again omitted to show the principle upon which his facts are based. *The circumference of a circle = diameter* $\times \pi$ ($\pi = 3{\cdot}1416$), and if, therefore, we have two circles, A and B—A with diameter 8 ft. and B with diameter 12 ft.—then the difference of the circumferences of A and B $= \{(12 \times \pi) - (8 \times \pi)\}$ ft. $= (4 \times \pi)$ ft. If A and B had diameters of 10 and 15 ft., the difference of the circumferences would be $\{(15 \times \pi) - (10 \times \pi)\}$ ft. $= 5 \times \pi$ ft. Thus we see that the difference of the circumferences of two circles is always *the difference of the diameters* $\times \pi$; and hence, when the difference of the diameters is always the same, the difference of the circumferences is always the same, no matter how small or how great the circles may be. This, as might be expected, is not the case with the difference of the areas of the circles, that difference being proportional to the difference of the *squares* of the diameters or radii.

Your correspondent also, in quoting from "Whitaker's Almanack," has given us *the diameter of Venus instead of the diameter of the Earth*, which is 7,926 miles ("Whitaker's Almanack," 1888, page 78). One error, however, is a great improvement on four, and seems to show that "A. P. T.'s" type-writer is not quite as incorrigible as he would have us believe.

KUKLOS.

COSMICAL ORIGIN OF HAILSTONES.

Ordinary meteors fall on our earth in their own time and without waiting for any special terrestrial weather. Hailstones, on the other hand, choose suitable conditions and appropriate weather. If Schwedoff's theory (mentioned by Mr. Williams in "Table Talk," No. 26 and following pages, be correct, we ought to hear of an occasional hailstone or shower of hailstones at times when terrestrial conditions are diametrically opposed to their production. Is there record of any such occurrence? If not, this seems to show a weak point in the theory.

F. M.

THE COLDNESS OF JULY 11 AND 12.

As a rule, the hottest day in the year in London is July 16th. We are therefore within a week of that date, and yet for two days I have been luxuriating in the warmth of an ever-ready gas fire.

It would not be at all difficult to find two days in January warmer than these two in July; but as it would be rather confusing to compare with two, I take only one—the first that comes to hand:—

	Minimum. Deg.	9 a.m. Deg.	Maximum. Deg.
1877—January 1st	49·3	50·0	54·0
1888—July 11th	42·8	45·4	55·7
1888—July 12th	45·4	49·9	54·2

These two days have therefore been colder than the 1st of January—July 11th by 5·1 deg. and July 12th by 3·2 deg. Memory is not a safe guide, but I remember no parallel in July.

Some years back Mr. Glaisher, F.R.S., worked up the daily temperature at Greenwich from 1814 to 1873, and in that long period I can trace no days in July at all comparable with these, except two, one in 1836 and one in 1856. The precise figures are as follows:—

Mean Temperature at Greenwich.	Deg.	Mean Temperature at Camden Sq.	Deg.
1836—July 20 ..	47·7	1888—July 11 ..	46·2
1856—July 8 ..	48·0	1888—July 12 ..	48·1

Wednesday, July 11th, is therefore absolutely without precedent, and to-day is very nearly so.

G. J. SYMONS, F.R.S.

62, Camden Square, N.W., July 12.

FECUNDITY OF SPARROWS.

Your correspondent, Mr. J. P. Nunn, states in his letter (Scientific News, II. p. 21) some very interesting facts concerning sparrows, but, unless these birds are remarkably prolific, I should like to know why they so far outnumber all our other species of land-birds. Sigma.

RECENT INVENTIONS.

The following list has been compiled especially for the Scientific News *by Messrs.* W. P. Thompson *and* Boult, *Patent Agents, of 323, High Holborn, London, W.C.; Newcastle Chambers, Angel Row, Nottingham; Ducie Buildings, Bank Street, Manchester; and* 6, *Lord Street, Liverpool.*

Producing Currents of Air.—A fanning apparatus has been patented by Mr. A. J. Boult, on behalf of F. Bisson. The apparatus consists of a rotary fan mounted in bearings; on the axis of the fan a small pinion wheel gears with a wheel of larger dimensions, and has a rotary motion imparted to it in each direction alternately; the motion in one direction being produced through a cord mechanism by the person using it, and in the other by a suitable weight or spring.

Milk-pan.—A milk-pan has been patented by Mr. J. Llewellin. The pan is constructed of a shallow receptacle, having hollow walls in two parts, the bottom of which are dish-shaped. The space between the two parts receives hot or cold water, to regulate the temperature of the milk, which is placed in the inner portion, thereby causing the cream to rise. The water is introduced through an opening having a cover, and the pan has a tap in the middle of the bottom to allow the water to be drawn off.

Anemometers.—An anemometer has been patented by Mr. J. Hicks. The object is to substitute metal pressure chambers in place of those usually used. A disc of metal is mounted on a suitably shaped chuck, and has spun upon it a number of concentric annular corrugations, the centre of the disc being formed with a tubular neck on one side, and its edge with a rim on the other side. Two of these discs are placed face to face, with the rim of the one within the rim of the other, and are soldered thus air-tight, thereby forming one section of the pressure chamber; any suitable number of these sections are connected together by the necks, which are placed one within the other, and spun over one another, and soldered air-tight. When required to indicate vacuum, the corrugated discs are made with convex outer faces and when for pressure they are made with concave outer faces. The interiors are protected by coating with india-rubber varnish and the exteriors with stove jet.

Transforming Electric Currents.—Mr. A. J. Boult has patented on behalf of S. Doubrava an apparatus for transforming electric currents. The invention is composed of a commutator consisting of a metal disc, revolving round a shaft. To the periphery of the disc are fastened insulating strips, and two contact brushes are so arranged that when one touches an insulating strip, the other touches the conducting part of the periphery. This commutator charges a condenser and discharges it afterwards into the circuit through a larger condenser. When the disc revolves, the second coating of the smaller condenser is connected with the generator by means of one of the brushes, the disc, and a sliding contact, and this coating is charged to the potential of the generator; by a further movement of the disc, this connection is broken, and the large condenser is connected by means of the other brush. By this means the smaller condenser is discharged into the larger one, through this into the circuit, and by the combination of these two condensers the potential will be lowered. By the combination of the condensers the high tension of the generator is changed into a lower one in proportion to the relative surfaces of the condensers.

Compass.—Mr. A. Gross has patented a compass for indicating when a vessel leaves its course. A hollow axle is fixed in the centre of the compass glass, and a forked piece of brass acting as a course setter is fitted thereon on the outside of the glass, with its ends resting on the rim of the compass. The axle is carried below the glass to within an inch of the compass card, and on its lower end is fitted another transmission fork. The ends of this fork are made of fine gold wires, fixed to have an outward spring and to reach the periphery of the card. The wires pass through the grooves of a slide and the perimeter ends are brought together or set apart by means of the slide operated by a pinion gear passing through the hollow axle, and having a racket adjustment fixed to it parallel with the glass. A piece of platinum wire is fixed at the north point of the compass connected with the magnetised bar of the card; this wire is bent to give spring power with the end pointing to the glass. The cap of the card is made of tempered silver steel. The wires of a battery are so connected with the compass bowl and alarm, that when either of the wires of the lower fork comes in contact with the platinum wire at the north point the circuit is complete. The wires of the lower fork limit the extent of deviation, so that when such deviation occurs the wires come into contact, and sound the alarm.

Switch.—A "bell pull" electric-light switch has been patented by Mr. A. P. Lundberg. The object is to produce a switch which will make good contact, and quickly "make" or "break" contact, and which, with every fresh pull, will make and break contact alternately. A disc is mounted on a base of any insulating material, so as to be free to rotate on a centre. Two metallic terminals, also on the base and rubbing against the circumference of the disc, are so arranged that every alternate quarter of a revolution of the disc causes metallic contact to be made or broken. The revolving disc has on its underside four pins fixed equi-distant from one another in a circle. Attached to the bases under the disc and pins is a bar, free to move vertically, having on its upper side a spring catch passing freely with the bar in a downward direction without disturbing the disc, but which engages with one of the four pins, when moving upwards, thus carrying the disc round a quarter of a revolution. The movement of the bar downwards and upwards will again move the disc through another quarter of a revolution by means of the spring catch engaging with the next of the four pins, and so, by continually rotating the disc, alternately making and breaking the contact. The bar has attached to it a spring which, left to itself, holds the bar in a fixed position, so that after being pulled down it returns to that position.

SALES.

The Charge for Advertisements in this Column is Sixpence for the first sixteen words, and Sixpence for every succeeding eight words. Advertisements for this Column should be received by first post on Tuesday to insure insertion in the following number.

Wanted, by two experienced Mechanics, Model Work to do at home (Mechanical or Electrical). Specialities and ideas worked out to drawings, scale, or size. Good workmanship guaranteed. Moderate terms.—P. R., 40, Westbury Street, S.W.

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Steel Name Stamps, 3d. per letter. Figures (set), 2s. 4d. Post free.—F. BALDWIN, Tuffley, Gloucester.

Meerschaum and Briar Pipes Repaired, Mounted, or Cased, ambers fitted.—W. GEORGE, 324, Essex Road, Islington, London.

"Precautions on Introducing Electric Light," by Killingworth Hedges. Cheap edition. 1s. 2d., post free.—GLOBE ELECTRICAL COMPANY, 7, Carteret Street, S.W.

EXCHANGES.

Exchange Notices will be inserted in this Column at the rate of Sixpence for the first twenty-four words, and Threepence for every succeeding eight words. Advertisements for this Column should be received by first post on Tuesday to insure insertion in the following number.

Splendid Solar Microscope, in case, by Nairne, six powers. Exchange photographic apparatus.—RIDOUT, Sunbury Common.

100 Geological Specimens, named. Exchange, 10s. Approval.—HOLDEN, Hoyland Nether, Barnsley.

SELECTED BOOKS.

Nature's Hygiene. A Systematic Manual of Natural Hygiene. By C. T. Kingzett, T.I.C., F.C.S., Ex-Vice-President of the Society of Public Analysts. Third edition. London: Bailliere, Tindall, and Cox. Price 7s. 6d.

A Text-Book on Steam and Steam Engines. For the Use of Students Preparing for Competitive Examinations, By A. Jamieson, C.E., F.R.S.E. Prof. of Engineering. Glasgow Technical College. With 200 illustrations and four folding Plates. Third edition. London, Charles Griffin and Co. Price 7s. 6d.

A Manual of the Mollusca. A Treatise on Recent and Fossil Shells. By Dr. S. P. Woodward, A.L.S. With Appendix by Ralph Tate, A.L.S., F.G.S. With numerous Plates and 300 Woodcuts. Fourth edition. London: Crosby, Lockwood and Son. Price 7s. 6d.

A Text-Book of Biology. Comprising Vegetable and Animal Morphology and Physiology. By J. R. A. Davis, B.A.; Lecturer on Biology, University College, Aberystwith. London: Charles Griffin and Co. Price 12s. 6d.

The Geological Evidences of Evolution. By Angelo Heilprin, Professor of Invertebrate Paleontology at, and Curator in Charge of, the Academy of Natural Sciences of Philadelphia. London: Trubner and Co. Price 5s.

Handbook of the Amaryllideæ. Including the Alstrœmerieæ and Agaveæ. By J. G. Baker, F.R.S., F.L.S., First Assistant in the Herbarium of the Royal Gardens, Kew. London: Bell and Co. Price 5s.

Electro-Plating. A Practical Handbook on the Deposition of Copper, Silver, Nickel, Gold, Aluminium, Brass, Platinum, etc., with descriptions of the Chemicals, Materials, Batteries, and Dynamo Machines used in the Art. By J. W. Urquhart, C.E. Second Edition. London: Crosby, Lockwood and Son. Price 5s.

Annals of Botany. Vol. ii., No. v. Edited by Professors Balfour, Vines, and Farlow, containing papers (illustrated by many plates). By A. Lister, G. Massee, J. R. Vaizey, F. W. Oliver, and other botanists. Notes and Reviews. London: Clarendon Press. Price 10s. 6d.

Water Engineering. A Practical Treatise on the Measurement, Storage, Conveyance, and Utilisation of Water for the Supply of Towns, for Mill Power and for other purposes. By Charles Slagg, A.M.I.C.E., author of "Sanitary Work in the Smaller Towns," etc. London: Crosby, Lockwood and Son. Price 7s. 6d.

METEOROLOGICAL RETURNS

For the ten weeks ending on Monday, July 9th, 1888. Specially prepared for SCIENTIFIC NEWS from official reports.

	Mean Temperature.	Rainfall.	Duration of Sunshine.
Scotland, East	49·5 degs., being 2·5 degs. below average.	5·9 ins., being 0·7 ins. above average.	449 hrs., being 20 hrs. above average.
England, N.E.	50·6 " " 3·0 " " "	4·1 " " 0·7 " below "	476 " " 55 " below "
England, East	53·6 " " 2·3 " " "	4·7 " " 0·0 " average	402 " " 104 " " "
Midlands ...	53·2 " " 2·3 " " "	5·3 " " 0·1 " above "	380 " " 63 " " "
England, South	53·2 " " 1·9 " " "	5·8 " " 1·3 " " "	395 " " 77 " " "
Scotland, West	51·7 " " 0·8 " " "	9·1 " " 2·5 " " "	444 " " 9 " " "
England, N.W.	52·5 " " 2·3 " " "	5·3 " " 1·0 " below "	391 " " 63 " " "
England, S.W.	53·6 " " 1·9 " " "	6·8 " " 0·6 " above "	435 " " 49 " " "
Ireland, North	52·1 " " 1·9 " " "	8·3 " " 2·5 " " "	413 " " 39 " above "
Ireland, South	54·2 " " 0·9 " " "	9·0 " " 3·0 " " "	434 " " 0 " average
The Kingdom...	52·4 " " 2·0 " " "	6·4 " " 0·9 " " "	422 " " 36 " below "

Rainfall at the close of the period had risen to nearly an inch above the average for the kingdom, its distribution continuing unequal. Temperature and sunshine below the normal.

Scientific News

FOR GENERAL READERS.

FRIDAY, JULY 27th, 1888.

CONTENTS.

SCIENTIFIC TABLE TALK.

By W. Mattieu Williams, F.R.A.S., F.C.S.

The mysterious behaviour of the satellites of Jupiter during transit (*i.e.* when travelling between us and the planet, and consequently appearing to cross his disc) has been observed and studied during the last 200 years. The phenomena in question are most decidedly displayed by the fourth satellite, which performs as follows:—On approaching the planet it becomes rapidly and increasingly fainter, until it touches the edge of the visible disc (the "*limb*," as it is technically called). When actually seen upon the limb it shines with moderated brilliancy for about ten or fifteen minutes; then it suddenly disappears, and remains invisible, in spite of using more powerful telescopes; after about ten or fifteen minutes more it reappears, but no longer as a bright moon. It has now become a dark spot, faintly grey at first, but gradually growing darker and darker, until it equals the blackness of its own shadow on the planet.

As a matter of course these curious changes have suggested many speculations, mostly unsatisfactory, until Mr. Edmund J. Spitta took up the subject, and by investigating it experimentally has at last solved the mystery.

His first series of experiments were conducted by cutting out a disc of cardboard, 3¾ inches diameter, to represent the planet, and other little discs of paper to represent the satellites, the proportions of their dimensions corresponding to those of the objects they represented. In the course of the experiments they were tinted with various shades, from white to dark grey, illuminated strongly by means of a condensing magic-lantern. These were placed about sixty yards distant from a telescope, and the results of placing the mock satellites in front of the mock planet were carefully observed.

The "albedo" or intrinsic reflected brightness of each of the differently shaded moons, and also that of the planet disc, were determined by means of Pritchard's wedge photometer, and it was found that when a moon of equal albedo to that of the planet was held by its fine wire stalk in front of the planet it became invisible, with smaller albedo than the planet it appeared dark, with greater it formed a bright spot, the differences varying with the gradations of tint. This is simply what anybody would expect *à priori*, but it was clearly desirable to establish it positively under the conditions of the experiment.

The next series of experiments were made to determine the effect of proximity of the planet to the satellite without actual superposition. These proved that as the larger and brighter disc approached the smaller and less brilliant the latter appeared less and less bright, the phenomena of the approach of the satellites to their primary being closely imitated.

Still, the mysterious changes, the extinction of the bright moon, and its reappearance as a dark spot remained unexplained, but so far the imitation of planet and moons was imperfect; the mock Jupiter was a flat disc, not a sphere.

Another series of experiments followed those above described; in these the disc of cardboard was replaced by a sphere of plaster of Paris 3¾ ins. diameter, the other conditions of these experiments being similar to the preceding.

The result is thus described by Mr. Spitta:—"It was found that the moons with the same albedo appeared black and grey as before, but what was far more surprising, that *all the phenomena of the dark transit could be completely reproduced.* I have witnessed the real phenomena very repeatedly, but I did not contemplate a reproduction from the employment of such simple means." He proceeds to describe this as follows: —"Whilst the dark moon having an albedo of 0·13 was advancing towards the artificial planet its light became fainter and fainter, but still of sufficient brilliancy to remain a bright spot when on the limb. Still continuing its journey across the artificial planet, and having arrived at an angle of about 65 degs. measured from the centre, it became lost to sight, reappearing on arriving at an angle of about 55 degs. to 60 degs. as a dark spot, which in a short time occupied in further progress became as black as its shadow. The effect was not a little surprising, seeing that it was totally unexpected."

Mr. Spitta's expression of angles in the above require explanation, his zero being the centre of the circular image of the sphere as seen in the telescope, and his 90° being the circumference or limb; the intermediate angles of course in accordance with this.

It was evident from the results of the previous experiments that these changes were due to differences of albedo in different parts of the sphere, as the flat disc of the moons could not thus vary, and, therefore, a positive determination of such variations became a work of considerable interest.

Mr. Spitta accordingly proceeded with this investigation, using the wedge photometer, which is a long wedge of glass originally used by its inventor, Prof. Pritchard, of Oxford ("the heavenly body," as the naughty boys there call him), for determining the so-called "magnitude" of stars by first inserting the thin end of the wedge between the observer and the star, proceeding until the light of the star is extinguished, and then noting the thickness of glass which produces this effect. This instrument was applied by Mr. Spitta (with precautions and modifications that space will not permit me to describe), to determine the albedo of his model planet, which he found to vary as follows.

Over a circle extending from centrality or 0° of Mr. Spitta's measure to 30° in all directions the albedo was not perceptibly altered. It was that of the material, and is represented by the figure.. .. .. 0·735

At 40° it was reduced to	0·500
" 50° " "	0·367
" 60 " "	0·323
" 65 " "	0·261
" 70 " "	0·172
" 75 " "	0·133
" 80 " "	0·080
" 83 " "	0·049
" 86·30′ " "	0·027

The decrease with obliquity is thus seen to accelerate rapidly, the loss approaching approximately to the tangent of the angle.

Here we have a curious physical fact, a strange optical illusion. If we look at a sphere such as a planet reflecting the sun's light, or a plaster-of-Paris ball reflecting a strong artificial light and placed at a considerable distance, we see a small disc which appears to be about equally luminous all over, but it is not so, nor nearly so. We are violently deceived either, by irradiation or some other optical proceeding not at present understood.

Adaptation of Structure to Habits.—Says Mr. F. P. Pascoe, F.L.S., in an interesting work on "Natural Selection": "We admire the structure of the forelimbs (so well adapted for burrowing) of the mole; but the rabbit, an unsurpassed burrower, is no more adapted for burrowing than its congener the hare, which never burrows. The common snake (*Tropidonotus natrix*), without fins like the viper, is a rapid and graceful swimmer, while the latter rarely goes near the water.'

THE NATURALIST AT THE SEA-SIDE.

III.—Shore Collecting.

The most discouraging circumstance about sitting down to write a short article on shore-collecting is that the thing has been done very well already. Lewes, Gosse, and Kingsley have all put on paper their own experiences, and being practised writers as well as keen observers, they were able to write lively and profitable sketches. However, their books are not in every house, and some of our readers, looking forward to seaside rambles, may be glad to be told how to set about shore-collecting.

Our first remark will be disappointing to some. There are many seaside places of popular resort likely to be fixed upon for a summer holiday where little can be done in the way of collecting plants or animals. A sandy shore is unpromising; so is the neigbourhood of a big, muddy river. It is true that even in such places as these the trained eye will find something of interest, but to the beginner they are barren. The good collecting grounds are rocky coasts, with deep, clear water, and shady pools overhung by boulders. As to time, the spring-tides (new and full moon) are much the best. For tackle, a shallow basket of no great size, jars of various kinds, and a hand net of strong muslin will be found indispensable. A small crow-bar and a stout hammer are desirable. It is hard to carry about all the implements which are likely to be wanted, and for this and other reasons a small party will usually fare better than the solitary rambler. Let us visit in the first place a rock-pool at low water. Hydroid zoophytes, polyzoa, anemones, ascidian colonies, and small fishes may be met with in such haunts. Lively little crustaceans will give employment to the net. Medusoids, left by the tide, may be seen pulsating in the clear waters. Another productive ground is to be met with around big blocks of stone. Turn over such as are not often shifted by the waves, and you will often find curious marine worms, some of monstrous size. To make the most of a good bit of shore the collector must not be afraid of wading out at low tide. He should leave his stockings at home, and walk out in strong shoes only.

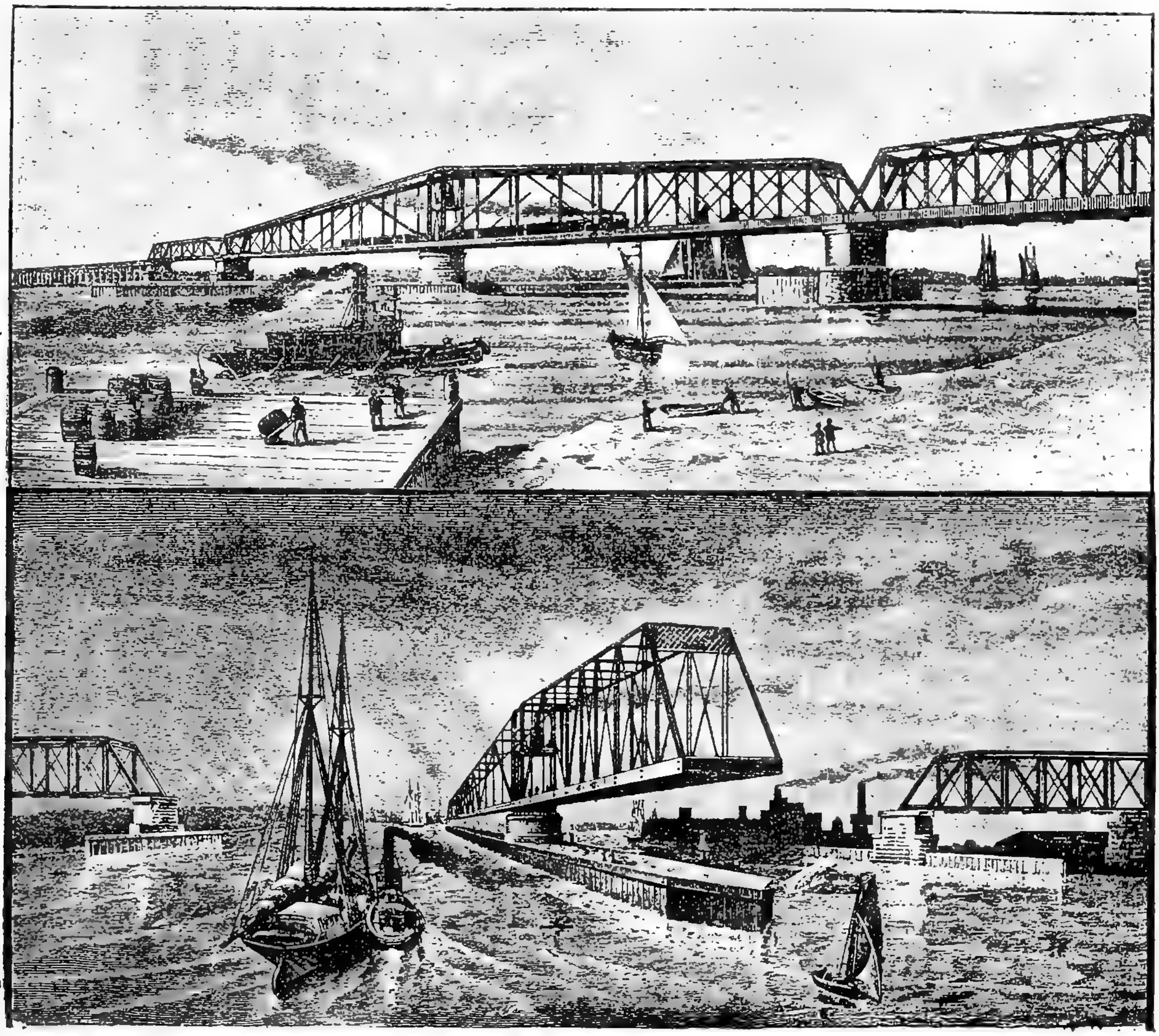
We advise those who mean serious work to bring back as much live stock as possible. Things that have dried in the sun, or have been shaken up with stones and sand, are seldom fit for real study. But many treasures of the deep, brought home in salt water, will live long in an extemporised aquarium, and may be anatomised or microscopised at leisure. Let the reader avoid the common delusion that to glue dried organisms upon white cards is useful work in natural history. A certain amount of thought must be put into every occupation if it is to turn out really productive. You cannot go far wrong if you set yourself steadily to make out points of structure, or to observe the mode of life of anything that crawls or swims. Have a note-book always at hand, and make endless drawings.

A very serious difficulty which besets the beginner is to make out what he has got hold of. Even the practised zoologist often needs a whole library of books to name his specimens. But if the determination of species be left to experts, a mere novice may hope with a little time and patience to find out what *kind* of animal he has before him. A living teacher is best by far, and a course of practical zoology gone through in advance will save much labour. So will a few visits to any tolerable museums of natural history. When actually on the coast, the collector must rely mainly upon one good, modern text-book of systematic zoology, which he will do well to have studied beforehand.

In a recent article (Scientific News, vol. ii., p. 30) we mentioned some preservatives which will be helpful. We may also refer to another article on the marine dredge (Scientific News, vol. ii., p. 60). The naturalist who wishes to make the most of his holiday should practise not only shore-collecting and surface-netting, but also dredging. If equipped with the modest provision required by these three modes of capture, he will have abundant occupation in fair weather, and a moderate amount of skill and good luck will bring him so much material that even a few wet days will be no hardship. The writer recollects with high satisfaction one stormy day in seaside lodgings, when a good fire was welcome, though the month was July. Torrents of rain dashed against the window, and there was no venturing out of doors till the cold and angry sunset came on. But hour after hour passed only too quickly, as fresh animals were placed under the microscope or in the dissecting trough. The notes and drawings made that day still bring back something of the delight which never fails to wait upon any step forward in the knowledge of nature.

THE LOW LEVEL BRIDGE ACROSS THE ARTHUR KILL.

OUR illustration, borrowed from the *Scientific American*, gives a view of the great swing-bridge spanning the Arthur Kill and connecting Staten Island, New York, with the opposite shores of New Jersey, thus opening up five or ten miles of additional water front to New York harbour.



Swing Bridge connecting the State of New York with the State of New Jersey.

The structure was erected by the Staten Island Rapid Transit Company. Its erection was authorised by an Act of Congress on June 16th, 1886, and two years were allotted for its completion. The plans and site were subject to the approval of the United States Secretary of

War, but he passed them without modification, after considering them for nine months. Work was at once commenced, but an injunction was obtained against the Company, which delayed progress for another six months. In spite of these difficulties, however, on June 13th, the swing-bridge was swung round from the open to the closed position, thus completing the bridge three days in advance of the stipulated time.

The trusses and swing-bridge are carried upon five piers of masonry, but much trouble was experienced in obtaining a solid foundation.

The entire length of the bridge proper, exclusive of approaches, is 800 feet. It comprises two shore spans, each 150 feet long, covered by fixed trusses, and two draw spans, closed by the great draw-bridge. The draw-bridge is said to be the largest now in existence, its total length is 500 feet. When open there is a clear water-way 208 feet wide on each side of the central pier.

The draw span was put together in four weeks, and the machinery was installed in another fortnight. The draw contains 656 tons, and each of the approaches 85 tons of metal. The approaches have yet to be made, but it is anticipated that by the end of August trains will be running across the bridge.

POISONS IN THE WORKSHOP.

(*Continued from page 14.*)

Of all the dangerous materials employed in the arts and manufactures, perhaps the one most to be dreaded is lead. This we say not by reason of the violence of the symptoms which it produces if introduced into the human body, but on account of the insidious nature of its attacks, and of the great number of manufacturing operations in which it plays a part.

We are not aware that the lead-miner is liable to diseases more and other than those which in general befall persons employed underground. Nor are the men employed in smelting and refining lead, in the manufacture of sheet-lead and leaden piping, of shot, and of the chief commercial alloys of this metal, such as plumbers' solder and type-metal, very frequent sufferers from lead-poisoning. The reason for their comparative immunity is that they have to deal with the noxious substance in a solid, insoluble, and non-volatile state. Their work, too, is very generally performed in the open-air or in open sheds. But it is when lead is made the subject of chemical operations that its hurtful character is most felt.

Foremost among the dangerous preparations of lead stands the well-known paint white lead, a carbonate, or rather a mixed carbonate and hydrate of lead. Into the manufacture of this pigment there is no occasion for us to enter. But it is produced and consumed in vast quantities, and often occasions in the workmen who make or who use it the most characteristic and distressing symptoms of lead-poisoning. The victim experiences severe cholic, "wrist-drop" sets in—that is, the hands hang down uselessly at the wrist or can be raised only with great difficulty—a general tremor is experienced in all the limbs, and sometimes complete paralysis comes on. The cause of the mischief is revealed by a blue-black line in the gums below the roots of the teeth.

Much of the ill-effects of the white lead manufacture may be avoided by due care on the part of the men. The chief precautions are strict attention to personal cleanliness, so that none of the dust of the white lead may remain on the skin. No food or drink should ever be partaken of or be allowed to remain in any of the work-rooms, and "sulphuric acid lemonade" — that is, sweetened water with a few drops of *pure* sulphuric acid to the glass, enough to communicate a pleasant tartness without setting the teeth on an edge—should be used as the ordinary drink. It is not pleasant having to admit that in some cases where white lead manufacturers have provided protective appliances, such as hot baths, a room where such of the men as live at a distance may take their meals away from the poisonous substance, all such precautions are neglected, if not positively refused. But the habitual use of white lead is as dangerous as its manufacture. The house-painter is constantly using white lead, not merely alone, but as an ingredient in most compound colours. The turpentine with which so many oil colours are mixed is highly volatile, and carries particles of white lead, too minute to be visible, into the mouth and lungs. Hence the painter—it is a painful deficiency that in the English language one and the same term is applicable to the artist and to the man who coats window-frames, doors, and walls with colours—is open to cholic and paralysis just like those employed in white lead works.

In the hopes of escaping this evil, a variety of substances have been proposed as substitutes for white lead, but none of them appear to suit the demands of the trade to an equal extent. Zinc white has, indeed, been used in practice to a very considerable extent, and possesses the great advantage of not becoming discoloured if exposed to sulphuretted hydrogen, coal-gas, etc. Another fraudulent use of white lead has been an unsuspected cause of poisoning. Everyone in these days knows what is meant by "weighting" or "loading" silks—a variety of practices by which a pound of genuine silk is converted into from 18 to perhaps 40 ozs. of a something which can, at any rate, be sold as silk. Now, in the case of white sewing silk this loading is chiefly effected by means of white lead, which is deposited on or attached to the fibre. Hence sempstresses, or ladies who often make use of white sewing silk, especially if they have the bad habit of biting off the ends of the thread, or trimming it with the lips before threading the needle, have been known to suffer from lead-poisoning.

Girls employed in artificial flower-making, especially in the case of wax flowers, are often similarly attacked, as very many of the pigments used contain white lead, alone or in admixture.

The manufacture of rubber articles is also not unattended with danger, as compounds of lead are not unfrequently employed for giving weight. Lead meets us further in the paper-hanging trade. Perhaps it may have been somewhat overlooked because the attention of physicians, analysts, and of the general public has been mainly turned to the arsenical compounds still, unfortunately, in so common use. But the lead is also there, and does its share of mischief.

Red lead is much less poisonous than white lead. It is less soluble in the secretions of the body, much denser, and hence less liable to form dust, and its use is much less general.

Chrome-yellow, the chromates of lead of various shades, will be discussed among the compounds of chromium, of which we shall speak below.

Tin and zinc are both more evidently poisonous than lead. Yet their employment in the arts presents little danger. We have, in former years, superintended the conversion of tons of tin into mordants, and their employment in dyeing, tissue-printing, and colour-making, but we never witnessed any injurious effects from close and frequent contact with the solution of this metal. Indeed, in the manufacturing districts we have heard the saying that a dead dyer is as great a rarity as a dead donkey. (*To be continued.*)

WHIRLWINDS AND WATERSPOUTS.—I.

ALTHOUGH we have on two or three occasions referred to these strange incidents, we do not believe that our readers will object to a further notice of this momentous subject. Momentous, we may venture to call it, since from the trifling eddy of dust which we see before us on the highway, up to the waterspout which may overwhelm a vessel or ravage a plot of land, the revolving sand-pillars in the desert which have been known to bury a passing caravan, and even to the tornado and the hurricane, there is evidently one continuous chain of phenomena, differing in magnitude, but essentially alike in their laws and their causes.

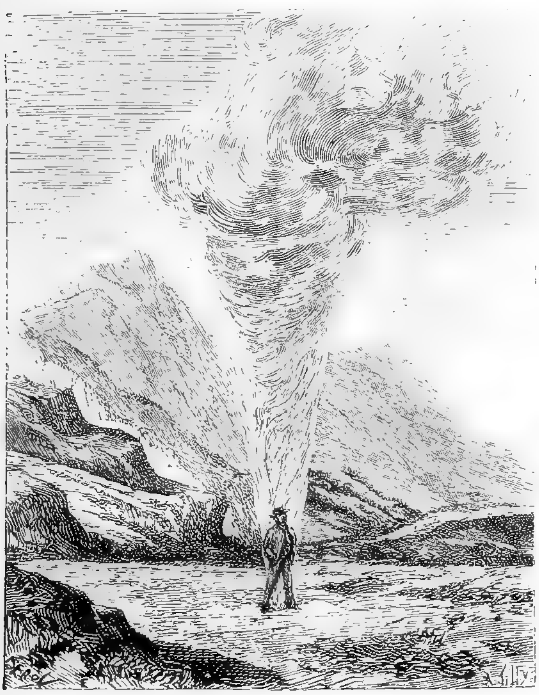


FIG. 1.—OBSERVER WITHIN A WHIRLWIND, EXPERIENCING THE SENSATION OF A VERTICAL MOVEMENT.

It is doubtless too much to hope that mankind will ever be able to prevent these catastrophes, but very much would be gained if we could obtain a few days' warning of their approaching outbreak. The aborigines of the West Indies, whom the earliest European settlers extirpated are said to have been able to foretell the advent of a hurricane for a week or more. That we, with our instruments of precision, cannot do as much is not to our credit.

We here reproduce from *La Nature* representations of whirlwinds or dust-storms witnessed by M. H. Duhamel, of Gieres, Vice-President of the Isere section of the French Alpine Club. This gentleman, referring to the phenomena, described and depicted (SCIENTIFIC NEWS, p. 561) writes :—"I have been present at the formation, the transference, and the ultimate disappearance of at least fifteen whirlwinds or spouts of dust and of snow exactly resembling in height and shape that at Vincennes described by M. Gibert, but I have never seen the bodies raised collect in an opaque globular cloud as in the whirlwind observed on May 13th last. In my observations the top always lost itself, forming a sort of streamer. All the whirlwinds which I have seen showed a movement of translation more or less regular, but the rotatory movement has always seemed to me to be from the right to the left. I have placed myself inside (fig. 1) whirlwinds of different sizes, and have always felt very distinctly both at the margin and in the middle an unquestionable sensation of upward motion. I am certain that the matters carried up are distributed through the entire mass of the whirlwind. This I have not seen, but smelt in case of dust, and in case of snow or storm I have felt its contact with my person.

FIG. 2.—TRICYCLIST RIDING THROUGH A WHIRLWIND WITHOUT STOPPING ITS FORMATION.

Another point to be noted is that on placing myself in the centre of a whirlwind it has never vanished. Its action has not been in any way disturbed by my presence. On three or four occasions I have amused myself, among other places, on a road crossing the plain of Graisivaudan between Gieres and Grenoble, by passing at a great speed through a whirlwind (exactly of the shape and size of that at Vincennes), but in spite of the current of air caused by my transit upon a broad and high tricycle (fig. 2) the little whirlwind was not in the least disturbed by this trial.

I must add that during the fifteen years for which I have been in the habit of travelling on this road I have always seen the whirlwinds formed at the same spot, within, say 150 yards. But this place, situated in the midst of the plain, seems exposed (at least in the upper layers of the superincumbent atmosphere) to an enormous current of air from the north-east, coming through a pass in the mountain chain of the *Chartreuse*, opening upon the valley of the Isere at an altitude of about 2,600 feet above the latter.

I cannot too strongly insist upon the absolute agreement of M. Glbert's observation with all mine. The aspect of the furrow traced *through* or *in*, not *over* the dusty soil is scrupulously accurate. This furrow records in a manner the oscillations of the base of the whirlwind in its twofold movement of translation and rotation.

(To be continued.)

THE STABILITY OF THE FAUNA.

IS the proportion of the several animal species in any country fluctuating or permanent? In spite of the occurrence of such well-known facts as the decline and ultimate disappearance of certain living forms within historical ages, Professor K. Fuchs, of Pressburg *(Humboldt)*, argues with great ability that, disregarding trifling changes, these proportions may remain unaltered for thousands of years, if only the climate and the vegetation do not vary. He, of course, excepts the direct or indirect agency of man, which makes itself widely felt as a disturbing factor, and that very frequently to his own injury. The Professor shows that the animal world is self-regulating: any increase or decrease in the numbers of some given species involving at once a corresponding—and sometimes more than proportionate—decrease or increase in some one or more other species. This fact, apparently very simple, involves a number of reciprocal bearings not unworthy of a passing notice.

We may first glance at the mean duration of the life of animals. It may be readily shown that the mean life of an animal is inversely as its reproductive power, *i.e.*, the more fertile any species the shorter is the life of the individual, whilst animals which multiply slowly necessarily reach a high age. Let us assume, to prove this point, that the reproduction of the hare is 2 per cent. or one-fiftieth daily, that is, among 100 hares two are born daily (a quite arbitrary figure). In this case the number of hares can be permanent only on condition that their daily mortality is also 2 per cent. or one-fiftieth out of every 100 hares, two dying on the average daily. In other words, the death-rate must balance the birth-rate. Great fertility is, therefore, for the individual a mournful gift of Nature. We find, in fact, that small creatures which multiply very rapidly, are correspondingly short-lived. The small mean duration of life is generally effected amongst animals by a numerous destruction of the eggs and the young brood, and it does not, theoretically speaking, prevent individuals from attaining a high age.

What is the practical value for an animal of endurance, the power of prolonging its life under unfavourable circumstances, such as poor food, deficient shelter, a bad climate, in short, conditions which make existence a burden? Animals which, like most beasts of prey, rarely meet with a violent end will generally increase until, by dint of deficient food, etc., the death-rate equals the birth-rate. In enduring animals, especially if they have the misfortune to increase rapidly, so that great mortality is needed to effect an equilibrium, as among the dog tribe, this condition is reached only when the general want has become very urgent. They are thus, so to speak, predestinated to distress, and their characteristic attributes, such as outrageous voracity, restless prowling and searching, have been evolved in consequence. Unenduring animals, *i.e.*, such as quickly perish under unfavourable circumstances, and which, in addition, increase slowly, so that a balance is reached even with a low death-rate, are destined for a lordly existence. As soon as want sets in their mortality rises, their numbers fall, and single individuals obtain scope, in consequence of decreasing competition, to find better food and shelter.

Endurance, combined with rapid increase, presents advantages where times of scarcity and times of plenty alternate, say in the succession of summer and winter, or of dry and wet seasons. The numbers which such species may reach at the end of the good season render it probable that few places of shelter will remain undiscovered and unutilised, whilst the power of endurance will minimise the number of individuals which perish in the bad season. Hence we may expect to find enduring and fruitful animals in extreme climates, and non-enduring and slowly-multiplying species in equable climates.

We shall find much instruction from the theoretical case of a country inhabited only by a single food-animal, say the hare, which can find food without limit, and which encounters only one devourer, say the fox. It will be seen at once that in such a case the foxes, faring abundantly upon the plentiful hares, will increase, and in virtue of their growing numbers will extirpate the hares daily more and more until the number of the latter is so far reduced that the foxes cannot catch a sufficiency, and begin to die out from want until they can catch no more hares than are born in the meantime. We then find an equilibrium. The hares can be considered as rendered stable when so many foxes are present as to devour the daily increase of the hares, so that the number of hares remains unaltered. On the other hand the number of foxes may be called stable when hares have become so few that, in spite of all exertion, as many foxes die from famine as are born in the meantime.

As soon as any species increases above the equilibrium, it digs its own grave: the fox, in the case we have been supposing, by eradicating the hares, and the hares by facilitating the increase of the foxes. Inversely each species improves its condition by falling below the normal number: the fox, by rendering an increase of the hares possible, and the hares by contributing to the dying out of the foxes.

A very interesting and seemingly paradoxical result is that as both the devourer and the devoured reach higher numbers the more difficult it becomes for the robber to seize his prey, the harder the booty is to catch. In proportion as the conditions of the chase become less easy, the numbers of the food-animal increase, since the devourer meets with his minimum supply only when the food-animal is numerous. But—and this is the peculiar point—the devourers will increase because, from the great numbers of their prey, more of the former can exist than previously. Nature, therefore would do the beasts of prey an ill service if she made the chase easier, either by giving them greater resources, or by placing at their disposal more helpless and unprotected food-animals. They would soon devour down their prey to such a low number that few devourers could exist.

(To be continued.)

General Notes.

THE FRENCH ACADEMY OF SCIENCES.—Professor Langley, of the Allegheny Observatory, has been elected, by a large majority, a corresponding member of the Academy for the astronomical section.

THE ADULTERATION OF "SPANISH JUICE."—According to Mr. B. Dyer, F.C.S., the substance sold as Spanish juice is largely adulterated with starch and glucose. The worst samples are those of French origin.

ANTI-RABIC HOSPITALS.—According to *Cosmos* there now exist in the world twenty-three establishments for the preventive treatment of hydrophobia on the principle of Pasteur, and all conducted by his pupils.

THE UNITED STATES SIGNAL SERVICE.—It appears probable that this department, which has rendered such signal services in meteorology, will be administered in future by civilians instead of, as heretofore, by military men.

EXPEDITION TO LAPLAND.—A Russian expedition, under the direction of M. Bashlund, an eminent astronomer, will be despatched to Lapland in August or September. M. Latkin, a St. Petersburg merchant, is providing the necessary funds.

SMALL-POX IN MARTINIQUE.—In this island, containing a population of only 170,000 persons, there have been already, according to a communication of Dr. Talairach to the Academy of Medicine, 2,300 deaths from this disease. The epidemic still continues.

JOINT ACTION OF AIR AND LIGHT UPON METAL PLATES.—MM. Bichat and Blondlot communicate to the *Academy of Sciences* that if the rays of an arc-light are thrown upon a sheet of brass, and a current of air is directed against it at the same moment, a well marked electric action is set up.

CARBO-DYNAMITE.—In this explosive, patented by Messrs. W. Borland and W. Reid, the nitro-glycerine is combined with carbon instead of kieselguhr. Its explosive force is greater than ordinary dynamite, owing, it is said, to the carbon absorbing a greater quantity of nitroglycerine than the kieselguhr.

DISCOVERY OF AN OLD ROAD.—In making the Manchester Ship Canal an old footpath or road has been discovered near Netherpool, about a mile and a-half from Eastham. The road is fifteen feet below the surface; it is paved in the centre with pebbles or boulders from the shore, and the curbs are built of blocks of red sandstone.

BRANDY FROM SAWDUST.—A certain Herr Zeterlund, by boiling sawdust with hydrochloric acid under pressure, is said to have converted a part of it into glucose, from which alcohol was then obtained by the ordinary process. He calculates that each hundred-weight of air-dried sawdust might be made to yield at least 27 quarts of a 50 per cent. brandy.

THE EFFECTS OF EMANCIPATION ON THE AMERICAN NEGRO.—A medical contemporary states that the deterioration of the race, physically and socially, is unquestionable. Before the secession tuberculosis was almost unknown upon full-bred negroes; to-day their death-rate from this disease is twice that of the whites. Insanity, also, is becoming fearfully prevalent among them.

ARSENICAL GLUCOSE.—According to the *Journal des Brasseurs* arsenical glucose, *i.e.*, containing arsenic derived from the sulphuric acid used in its production, is met with in commerce, and may be used in brewing and in the preparation of articles of food. The *Société d'Encouragement pour l'Industrie Nationale* offers a prize of 2,000 francs for the production from pyrites of sulphuric acid free from arsenic.

SILPHA OPACA.—We have already referred to the fact that this beetle has developed a taste for beet, and is giving French farmers a good deal of trouble. According to Miss Ormerod, this carrion beetle has also developed a taste for mangolds, and she has just issued a caution to farmers, but unfortunately no remedy is known which will check the depredations of the insects if they appear in sufficient numbers.

THE HITTITES.—It seems probable (*American Naturalist*) that the renowned Hittite city, Carchemish, is to be sought at the site of Jerablus, from which the British Museum obtained, a few years ago, most of the Hittite monuments in its collection. The heads sculptured in these monuments are in many cases adorned with a pig-tail, similar in shape and position to that worn by the Chinese. The wearers of the pig-tail have Mongolian countenances, and it seems that a Mongolian race had obtained supremacy in some of the Hittite cities.

GRASSES.—Mr. W. Wilson, jun., of Alford, N.B., has made some interesting observations on the growth of grasses. He found the first to appear above ground is the vernal grass, and is of opinion that it would make an excellent early fodder if introduced into sheep pastures. The crested dog's tail persistently throws up leaves throughout the year, and Mr. Wilson thinks that in many situations a liberal introduction of it would afford succulent food for the whole season. Red, hard, and sheeps' fescue were the latest grasses to start into activity.

A NEW THERMOMETER.—A new thermometer for measuring the temperature of the air has been constructed by R. Assmann. In order to protect it from influences of radiation and other sources of heat, he inserts the bulb of the thermometer in a metal tube which is open at its lower end. An aspirator is fastened to the tube near the bulb, and a continuous current of air of about seven feet velocity passes the latter. Thus it assumes the true temperature of the air. The tube is made of highly-polished nickel-plated brass, in order to protect it from radiation. Experiments show that this thermometer gives entire satisfaction.

INFLUENCE OF THE MOON.—A recent writer upon the subject mentions that at the Cape and in India woodcutters insist that at full moon timber is full of sap and unfit for cutting. At the Cape, nuts and other provisions are said to spoil rapidly if exposed to moonlight, though this may be due to the fact that the light serves as a guide to the insects. The editor of the *Journal of Microscopy* adds, in comment, that from many years residence in Essex he is well acquainted with the fact that no farmer's wife (of the old school) will pickle hams in a waning moon. The days between new and full moon are chosen by the farmer to kill swine for home consumption, because, they say, the meat will swell with the moon, but in a waning moon it will decrease.

Detection of Cotton-seed Oil in Olive Oil.—Ernest Milliau has, says the New York *Jewellers' Weekly*, recently discovered a new, simple, and effective means of testing the purity of olive oil, which by many watchmakers is considered the best lubricant. This oil is frequently adulterated by the addition of cotton-seed oil, and M. Milliau has ascertained that nitrate of silver causes the two oils to separate. In order to test the oil it must be mixed with three times its volume of methylated spirits. The nitrate of silver is then diluted in water and poured into the mixture. If there be any cotton-seed oil it will rise to the surface in the form of a black paste. By this means the presence of even so small a quantity of cotton-seed oil as 1 per cent. can be discovered.

Miklucho Maclay.—We regret having to put on record the death of Dr. Miklucho Maclay, at the early age of forty-two. Having studied medicine and the natural sciences at Petersburg and Leyden, he visited Madeira in 1866, in company with Prof. Haeckel, of Jena, and afterwards Morocco and the Canaries. In 1871 and 1872 he explored the north-western and south-western coasts of New Guinea, and visited Farther India, Malacca, and the Malay Islands. In 1876-78 he explored the northern coast of New Guinea. He revisited this island in 1879, and finally returned to Russia in 1882. He had resided for some time at Sydney, where he founded a marine biological station. The greater honour belongs to Dr. Miklucho Maclay because, unlike another eminent Russian traveller, he could not be suspected of being a political or military spy.

Deposits of Lignite in Italy.—The rapid rise of Italy as a nation has naturally increased her desire to be self-supplying in coal for her war-ships, as well as for commercial purposes. Many attempts have been made to find this all-important mineral, but hitherto without success. Lignite, however, exists in large beds, and has been successfully used in the great iron and steel works at Terni. A new and apparently very extensive deposit of lignite has been found on the estate of Monteguidi, midway between Siena and Volterra, and in the vicinity of the boracic acid works, formerly worked by Count Larderello. The estate having been recently purchased by an Englishman, some specimens of the lignite have been brought to England for examination, and it seems that its heating power is 80 per cent. of Newcastle Hartley coal. This would therefore seem to be the nearest approach to a coal-find in Italy.

Application of Carnot's Principle to Endothermic Reactions.—M. Pellat, in a communication to the Academy of Sciences, shows the impossibility of effecting endothermic reactions in opaque vessels at low temperatures. But this impossibility no longer exists if we allow a source of intense heat to act by radiation, a fact which is commonly expressed by saying that light effects the reaction. Thus the carbonic acid of the air is decomposed at ordinary temperatures by the green parts of plants, and the carbon combines with the elements of water. This is a decidely endothermic reaction, and it is therefore possible only by the radiation of an intensely heated body, the sun. The chlorophyll reaction can take place only under the influence of a radiant body of a higher temperature than that at which vegetable products become ignited. The higher the temperature of a radiant body the more its spectrum extends towards the ultra-violet. This explains the efficacy of the most refrangible radiations in setting up chemical reactions.

Ascent of Mount Kenia.—According to the *Times* a despatch just received from Zanzibar states that the Hungarian Count Teleki, who has been travelling for some time in the interior, was, in December last, on Lake Barengo. The Count had had numerous fights with the natives, but had always been victorious and had his caravan well in hand. He had ascended Mount Kenia, the lofty peak which lies far to the north of Kilima-Njaro. This mountain had never been ascended before, and Count Teleki states that it is higher than Kilima-Njaro, which is 18,700 ft. high; but, unfortunately, the Count does not give any figures. He proposed to go to the Samburu country and visit the lakes Basso Ebor and Basso Erok, as he calls them. His companion (a lieutenant in the Austrian Army) and himself were both in good health, and he proposed to return to the coast in November next. In this connexion we may state that Dr. Hans Meyer now admits that his original estimate of the height of Kilima-Njaro was incorrect; and that the old estimate of 18,700 ft. is more likely to be right. Dr. Meyer has just published in book form at Leipsic a narrative of his ascent of the mountain under the title of "Zum Schneedomdes Kilimaudscharo."

Image of the Moon.—The following account of a curious meteorological phenomenon is given by Herr Kammermann in the *Archives des Sciences Physiques et Naturelles*, and is reproduced in *Cosmos*. At the moment of observation (5.30 p.m., October 29th, 1887) the sky was almost entirely covered with cirro-cumulus, save in the east, where there was a broad band of black clouds rising about 15° above the horizon. These two kinds of clouds were separated by others partaking at once of the cirro-cumulus and the cirro-stratus, in which took place the phenomenon recorded. The moon seemed to be in this intermediate layer, and was surrounded by a well-defined halo of about 5° in diameter. The interior of the circle was of an orange yellow, and this colour gradually faded away outwards into a whitish shade. The distinctness of the halo struck the observer, who was astonished to see that the luminous disc which he had taken for the moon was not our satellite at all, for the moon just showed itself in a gap in the lower black clouds which had entirely concealed her hitherto. In about two minutes the mock moon disappeared, only the coloured circle still existed, and was evidently excentric to the moon, which was then at the edge of the lower belt of cumulus. In a few moments afterwards it disappeared behind the cirro-cumulus. The diameter of the mock moon was about the half or two-thirds of the lunar diameter. The distance between the false and the true moon was about 5°, the latter being then 13° above the horizon. Such a meteorological phenomenon does not seem to have been previously observed.

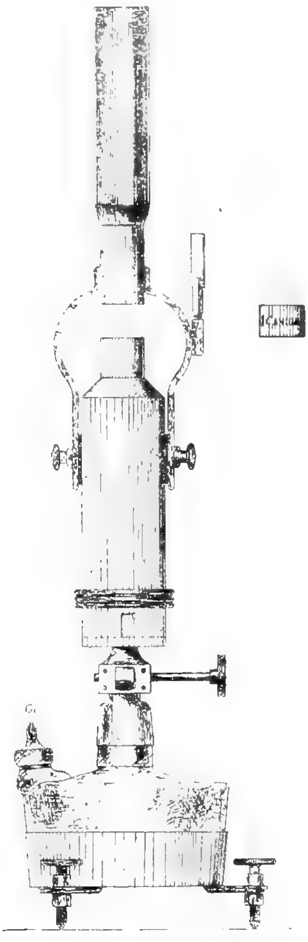
STANDARDS OF LIGHT AND ILLUMINATION.

THE fineness and precision of our senses in estimating quantities varies exceedingly, although they may be very sensitive to relative differences of magnitude or quality. One would think that the sense of vision was at least as well able to make a quantitative estimate as the senses of taste or touch. We have not much difficulty in guessing whether there are one, two, or three lumps of sugar in a cup of tea, or of telling by the muscular sense of weight whether a 'bus conductor has given two, three, or four pence in change; but it is very difficult to judge with the same amount of accuracy, small as this may be, whether a room is illuminated by two, three, or four candles; if they are placed close together, and their effect is seen, while they are themselves hidden from view. Indeed, it is not easy to see much difference between the illumination produced by ten candles and by twenty. The increase appears more like an addition of two or three candles only. Those who go early to a concert are often not aware that they have been sitting for some time in a room provided with about one quarter of the proper illumination, until the lights are turned up, when they suddenly realise that they have been waiting in semi-darkness. Neither the tea drinker or the *habitue* of the 'bus would allow himself to be thus deceived about sugar or pence.

There was no demand for a unit of light until the supply of gas became a subject of legislation. It was then enacted that the gas burned in an argand burner at the rate of 5 cubic feet per hour should yield a light equal at least to that produced by 16 sperm candles burning at the rate of 120 grains per hour. It is probable that the most unscientific legislator was conscious (if he thought twice about it, though this would be asking a good deal) that this was not a very accurate unit, but it is also probable that the most scientific was hardly aware of the numerous causes of error, the vagueness of the attempted definition, and the general untrustworthy character of the so-called standard. Spermaceti is not a definite chemical substance. No description of the wick is given, and not only can candles be prepared to suit either the producer or the consumer, but it is notorious that such candles have been made. But when the standard candles have been obtained, it is found that no matter what care is taken to avoid draughts or to provide uniform temperature, the illumination produced is constantly varying, and if two candles be found of exactly the same quality, and which burn at the same rate, they will not maintain the same light for even a few minutes in succession.

The very article for which the "Parliamentary candle" was to act as a standard, viz., the argand burner taking 5 c. ft. of gas per hour, has been put forward as a standard itself, it being claimed that when the flame is exactly three inches high, it gives a light of 16 candles, no matter what quality of gas is used. For disputes between the consumer and the producer of gas, or, indeed, any other illuminating agent, this is doubtless sufficient, but for anything of the nature of a measurement for the purposes of any scientifie determination, it falls far short of a reliable standard.

The French "bec Carcel" is an oil lamp which gives a light of about 9·5 standard candles. This is subject to nearly as great fluctuations as the candle while it is burning, while, of course, the most elaborate specification of its construction would not be sufficient to ensure a tolerable accordance between lamps produced by different makers, to say nothing of wicks and oil. A very simple device invented by Mr. J. Methven gets rid of the chief variations of the argand burner. He merely places a screen before it, and provides a rectangular hole which allows the light from the central part of the flame to pass, and the illumination is thus made independent of the height or the diameter of the flame. The quantity of light is evidently proportional to the intensity of the light of the flame, and this depends on the temperature of the combustion, and on the nature of the gas, although it is quite



HARCOURT'S PENTANE LAMP.

possible that the ordinary gas of commerce does not vary in quality to an extent sufficient to produce any serious error. A very excellent standard for most purposes, when it is in the hands of an experienced operator, is the pentane lamp of Mr. Vernon Harcourt. Pentane is a definite chemical substance which can be obtained with little difficulty, and different specimens may be relied on as identical. This lamp has no wick, and gives a very steady light. The original form of the lamp is only fit for a laboratory, for a current of air has to be maintained in an apparatus by which one volume of liquid pentane becomes vaporised and mixed with 576 volumes of air, forming a mixture, when vaporised, of 20 volumes of air to 7 of pentane gas.

Mr. Harcourt subsequently modified this lamp and exhibited it at the Manchester meeting of the British Association before the Physical Section. Instead of burning a mixture of air and pentane, this form of lamp burns pentane vapour only, and burns steadily, although it has no glass chimney round the flame.

From our illustration, which we owe to the courtesy of the Woodhouse and Rawson Electric Supply Company of Great Britain, it will be seen that the lamp is somewhat like an ordinary spirit-lamp, with a metal chimney above it.

The chimney is composed of two portions, an upper and a lower one, the latter being doubled so as to maintain the inner one at a constant temperature.

On lighting the lamp and placing the chimney in position the flame rises above the edge of the lower tube, and by suitable adjustment of the wick can be made to enter the upper chimney. In the latter are two slots diametrically opposite to each other, and the flame is raised so that its tip lies between the top and the bottom of these slots.

From experiments it has been learned that variations in the height of the flame do not produce much alteration in the amount of light radiated from its central portions; so to obtain a light of given candle-power it is only necessary to vary the distance between the upper and lower chimnies. To enable this to be done accurately, small gauges, one of which is shown to the right of the figure, have been made; one of these is placed on the lower chimney, the upper is lowered upon it, fixed in position by the clamping screws shown on each side of the lower chimney, and the gauge carefully withdrawn.

After the lamp has been burning for from ten to fifteen minutes there is scarcely any variation in the height of the flame, and consequently the light emitted is for all practical purposes constant.

The unit in Germany is a paraffin candle, 2 centimetres in diameter, with a flame 5 centimetres high. A lamp burning "pear oil," or amylacetate, without a wick is being introduced.

M. Violle has suggested a standard which should please those who are devoted to the French metric system. He proposes to take as a unit of light, the light emitted by one square centimetre of platinum at the point of fusion. Of course a larger quantity of the molten metal is used, and a screen with a hole of an area of one square centimetre is placed before it. A mixture of solid and of liquid platinum behaves like a mixture of ice and water. Although the ice may be melting, yet as long as there is any left, the temperature will be that of freezing point, and conversely if freezing is taking place. The addition or withdrawal of the heat only melts or thaws the ice, and does not alter the temperature of the mixture. This action ensures a constant temperature, and therefore a constant intensity of light, for the surface of the molten metal would be the same under all ordinary conditions. The original experiments were made with an oxy-hydrogen furnace of elaborate construction. Recent experiments, according to a paper by Mr. Dibdin, lately read before the Society of Chemical Industry, have been made with a thin sheet of platinum foil, with a screen in front, having a hole of a definite size, and a blowpipe behind, by means of which the temperature is raised until the metal melts, and a hole is pierced in the foil. The light, which was being continuously measured while it increased in strength, is considered to be of a standard intensity at the moment of the highest measurement, just before the foil melts. It is said that this gives more reliable and uniform results than might be expected. The foil is rolled off from one reel to another, so that the operation can be repeated with ease.

There are several important considerations as to the colour of the light which is to be measured, and its relation to the colour of the standard; for example, it is a matter of individual judgment rather than a matter of measurement to compare the light of a candle with that of an electric arc lamp. These considerations and the means of making the comparisons and measurements must be left for another occasion.

It is not, however, merely light which we want, but illumination. A badly arranged system of electric arc lights may give a considerable amount of light, but the illumination produced may be very bad. The amount of light required to illuminate a room is very difficult to calculate, since it depends not only on the superficial area of the floor, but on the reflecting power of the walls, and this is dependent on their colour and height. One authority gives 20 candles to 40 cubic yards of space, but it is impossible to apply such a formula to ordinary interior lighting. Out-door lighting is more easily reduced to rule, for there is but little assistance to be gained from reflection. For such cases Mr. Preece has suggested as a standard of illumination the illumination produced by a "bec Carcel" at the distance of a metre, which is equivalent to a "parliamentary candle" at 12·7 inches. The illumination at the foot of an ordinary lamp post is about one-tenth, and that of the full moon, on a clear night, is about one-thirtieth of this unit.

A New Cigarette Machine. — Messrs. Jadowsky and Schmitt have, after a long series of trials, perfected a machine for the manufacture of cigarettes, which is remarkable for its ingenuity and workmanship. The frame of the machine consists of a cast-iron table, supported on angle iron legs, and the various organs of the mechanism are geared to a main spindle, which receives motion either from a hand crank or by power from a belt. At each revolution of the spindle a complete cigarette with cardboard mouthpiece is turned out. The tobacco, slightly moistened, is placed in an open trough, the bottom of which is in part formed by an endless cotton band travelling forward under a knife, which automatically cuts off the quantity of tobacco required for one cigarette. This quantity is then pressed into a cylindrical form between a pair of semi-circular metal sleeves, and retained in this mould until a little piston pushes it into the paper envelope, which has, meantime, been prepared by another part of the machine. The tissue paper and the tape of cardboard for the mouthpiece are on separate rollers under the table, and the former is drawn between guide rollers under a printing roller, which prints the brand on to the paper. The paper band is then seized by a gripper, whilst a knife cuts off the length required to go round the cigarette, leaving sufficient length for the lap, which is gummed by being pressed against a roller. The piece of paper is next coiled over a mandrel, and then released from the gripper, which moves back to seize again the end of the paper tape, whilst the paper cylinder is pushed into a metal tube. Meanwhile the cardboard tape has undergone a similar operation, and a little cylinder of cardboard is pushed into the tube from the other end, where, through its own elastic expansion, it jambs itself tight into the tube of tissue paper. This receives now its charge of tobacco from the mould already mentioned, and the finished cigarette is thrown on to a travelling band, which deposits it in a box at the side of the table.—*Industries.*

Natural History.

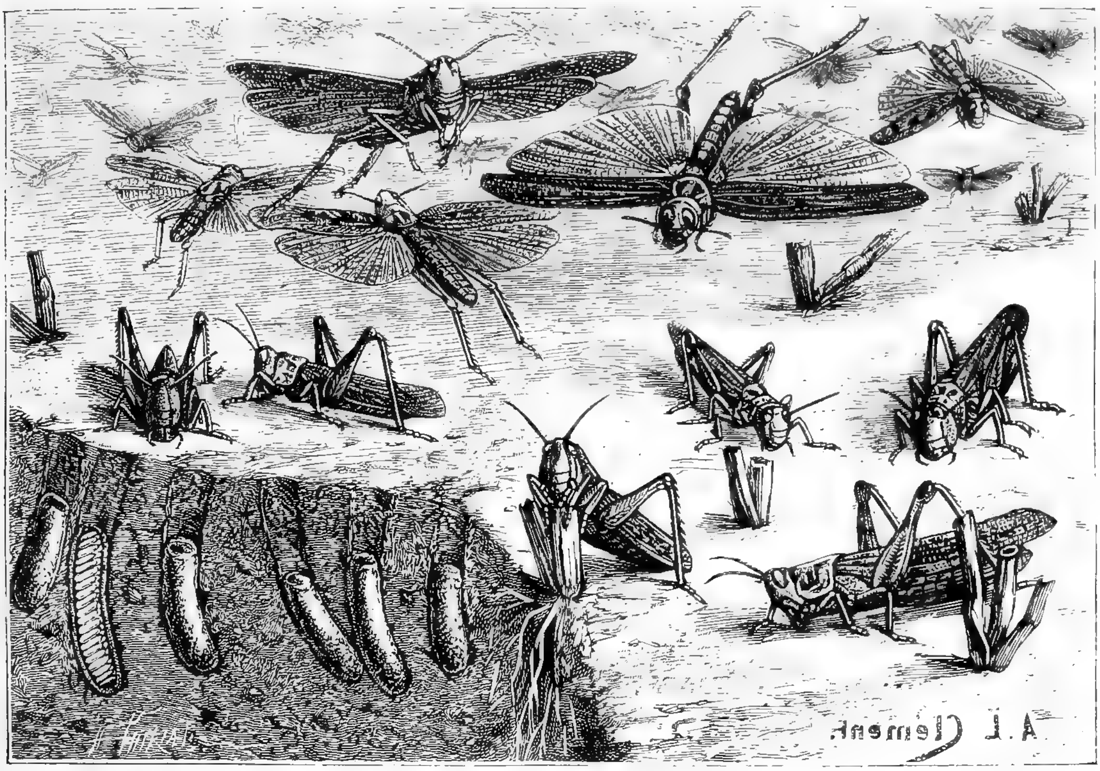
THE STAURONOTUS MAROCCANUS; ITS DEPREDATIONS IN ALGERIA.

M. KÜNCKEL D'HERCULAIS, the eminent French entomologist, gives the following report of his observations in the Algerian provinces attacked :—

In the district of Tiaret the surface covered by the eggs of these insects in 1886 was estimated at 8,400 hectares, a hectare being approximately 2½ acres ; in the district of Batna 130,000 hectares were infested; and in that of Setif the surface filled with eggs was more than 20,000 hectares. But these figures are far below the reality, since in the mountains there are immense egg districts which have escaped investigation.

Suppose that we are in April, and the sun begins to warm the soil. All at once, on the slope of the arid mountain where a deposit of eggs had been formed the year before, there issue from the earth thousands of small, white, feeble beings of about a quarter of an inch in length. On exposure to the light they soon take a dark-brown colour, and the earth seems sprinkled over with little black specks. Five men fell to work one day to count them into a quarter-litre measure, which held 12,285 individuals. This gives 50,000 to the litre, or 5,000,000 to the hectolitre. Hence we may calculate that each spot of 50 square metres may contain 25,000,000 of young locusts.

Six days elapse, when the little tender, delicate beings become strong in their limbs. Hunger makes itself felt, and they set themselves in motion, with a method, a regularity which many generals might envy. They do not march in column like the ants, or like our armies, but they advance forming a front of a more or less considerable extent. They do not appear to have any leaders, but they are doubtless directed by senses whose perfection we do not understand. Quitting the dry mountains, they march straight forward, traversing each day a regular stage. They travel from 9 a.m. to 3 or 4 p.m., and advance about 110 yards daily. They halt if a cloud overshadows the sun, and they suspend their march altogether if the temperature falls or if rain comes on. They undergo five successive moultings, and become more vigorous and agile. In two or three weeks they are half-grown and measure then about ¾ of an inch



LOCUSTS IN ALGERIA LAYING THEIR EGGS.

After the fifth moulting they measure 1 to 1¼ inch. The front of the army is now extended considerably. As long as the sun is above the horizon the invaders march on, running and leaping at the rate of more than 100 yards hourly. In the twelve days from May 21st to June 2nd they have been known to cross ten miles.

Their evolutions now become more interesting. Suppose we are on a fallow field ; we perceive the long and thick black line which marks the front of the invading army. We hear a peculiar rustling like that of a flock of sheep passing at a distance ; the army is at our feet and passes rapidly, but it reaches a field of barley and the pillage begins. It is wonderful to see the locusts nimbly climbing the stems. Five, ten, and more may be suspended to a single ear which bends beneath their weight. A few strokes of their mandibles cut away the protecting covering, and the tender grains are greedily devoured. The rear-guard eat up the fallen fragments and gnaw the lower leaves. In a few hours the promising harvest has disappeared, leaving merely the stubble as a sad witness.

When the army has thus marched for about 50 days, devouring all before it, it stops. The insects rest, their integuments split on the back, and they appear provided with wings.

They can still run and leap, but they can also rise in the air. For about a week they fly up and down, and then suddenly soar off in immense bands, flying at great heights as long as the sun is above the horizon. At sunset they descend and pass the night on the ground, resuming their flight the next morning. Soon they find upon the eastern or southern slope of a mountain, or on an arid plain, a spot suitable for depositing their eggs. The females run and leap about excitedly, sounding the ground here and there with their abdomen until a suitable spot having been selected, they bore the earth eagerly.

Nature has placed at their disposal admirable boring-tools; the extremity of their abdomen is armed with instruments having the appearance of hooks, but which we cannot describe here. The shaft is bored to the depth of nearly two inches, when they cease excavating and begin to lay. As the eggs are deposited they secrete a frothy liquid, which envelops them. At the same time each female covers her deposit with a layer of small grains of sand agglutinated together with great regularity. When thus covered, these egg-cases, buried to the depth of an inch below the surface, are so completely confounded with the soil that they escape even experienced eyes. Only the Arabs are able to detect them.

These egg-cases, or öotheca, shown in our illustration borrowed from *La Nature*, in which the report of M. d'Herculais is given in full, have the form of small cylinders slightly bent, rounded at bottom, and flattened at top. If we open one of these cases we find in it, symmetrically arranged, from thirty to forty eggs of a yellowish-white colour.

According to an old belief prevailing in Algeria, the locusts, miscalled crickets, which invade the country from time to time, belong to the species *Acridium peregrinum*. They are supposed to be brought by the Sirocco, from the Sahara and the Soudan. This is a mistake; they are bred in the arid and desolate mountains of North Africa, and belong to the species *Stauronotus Maroccanus*.

This insect, which of course belongs to the orthopterous family of *Locustidæ*, or, as the French prefer to call them, *Acrididæ*, is, when mature, of medium stature —the males being a little above an inch, and the females $1\frac{1}{2}$ inches in length. It is of a reddish testaceous colour, relieved with fawn-coloured spots. Its elytra are testaceous, with scattered brown spots and marblings. The wings are transparent. The design of the thorax renders it very easily recognisable. It has on each side a slight, oblique, and arcuated keel of a light yellow, bordered with brown within. On the sides is a round brown spot from which there issues a light yellow spot in the form of a crescent, more or less regular.

Sensitiveness of Plants.—It is not well known that plants, under certain circumstances, *e.g.*, in their alternations of sleep and waking, if subjected to variations of temperature, or if touched, perform certain movements which lead us to admit their sensitiveness, and compare certain of them with the lower members of the animal world, possessing not, indeed, distinct nerves, but what we may call a diffused nervosity. According to *La Nature*, M. Baillon has recently discovered a new fact in support of this view. The tendrils are one of the chief seats of the manifestations of that kind of sensibility which is observed in plants. Those of *Cissus discolor*, which the learned Professor of the Faculty of Medicine has studied, are extremely interesting. If one of the ramifications of a tendril are submitted to the slightest friction, there is formed at once a node which becomes the starting point of a curve. Mr. F. W. Oliver has also observed in the labellum of *Masdevallia muscosa*, a specimen of which flowered at Kew last year, some very curious movements. Some parts of the labellum possess such an irritability that the touch of a hair, or the wing of an insect, will make it assume quite abnormal positions.

The Fauna of Water-Mains.—Under this name Dr. Kraepelin (*Cosmos*) has studied the organisms found in the water supply of Hamburg. The water is taken direct from the Elbe without filtration. Hence many animal species living in the river are introduced into the underground conduits. Dr. Kraepelin has found about fifty species. Among fishes the most numerous are *Gasterostens aculeatus, Gadus lota, Pleuronectes flesus*, and especially the eel, some specimens of which reach the length of a foot. It has even happened that narrow pipes have been choked up by one of these fishes, just as it occurred some time back in the east of London. The Mollusca are represented by Gasteropods and bivalves. Insects are very rare, but small crustaceans swarm, and worms and polyzoa are numerous. The latter line the interior of the pipes with a mossy growth which interferes with the circulation of the water. Almost all fresh-water fishes, as well as most Articulata and their larvæ are absent. Species which breathe air from the atmosphere, and those which feed on plants perish; those which feed on detritus, and which breathe the air dissolved in the water, survive.

Locusts in Europe.—The same species which is laying waste certain districts of Algeria, is hard at work in Hungary over a vast extent of territory, especially in the counties of Moglod and Peczel, and in that of Pesth. The fields of wheat, barley, and maize, as well as the gardens, vineyards, and orchards, are being ravaged. Heavy falls of rain do not seem to have destroyed the insects. Another species is at work in Sardinia and in the neighbourhood of Rome.

A New Case of Parthenogenesis.—M. A. Ernst (*Cosmos*) believes that he has found a case of parthenogenesis in the vegetable world, in a plant which he has discovered near Caraccas. This plant, which yields fruits without having been fecundated, is named *Disciphania Ernstii*. The discoverer has cultivated several specimens of this plant with every precaution to prevent fecundation by the conveyance of pollen, either ot the wind or of insects.

Hatching Ova by Electricity.—Searching through some back numbers of the *Oesterrichische Landwirthschaftliche Wochenblatter*, we found it stated, on the authority of Dr. Virson, Superintendent of the Italian Experimental Silk Farm at Padua, that the hatching of silk-worm eggs may be accelerated by ten or twelve days, and a yield of at least 40 per cent. larvæ secured by exposing the eggs for eight or ten minutes to a current of negative electricity from a Holtz machine.

FRUITS.

CONSIDERED FROM A DARWINIAN POINT OF VIEW.

A STUDY of some of the common fruits that we eat at table gives us some excellent examples of the Darwinian theory of natural selection and the survival of the fittest.

Let us begin by comparing the botanical definition of a fruit with the structures popularly known under the term, "fruits." A fruit, as botanically defined, is simply the matured ovary of the plant after fertilisation has taken place; but in the case of many of the fruits we eat at table other parts of the flower are included.

The simplest form of fruit is simply a case enclosing a single seed; such a fruit is called an *achene.* The buttercup is a good example of this form of fruit, and each of the individual fruits of the strawberry is an *achene.* The seed case is known as the *pericarp,* and usually consists of three layers: an outer—the *epicarp*; a middle—the *mesocarp*; and an inner—the *endocarp.*

The simplest form of succulent fruit is the *drupe.* In this the seed case has become succulent and fleshy, and its three component parts are distinguishable, and have taken on different functions, for reasons we shall afterwards see. The epicarp forms an external, usually highly coloured skin; the mesocarp forms the succulent matter; while the endocarp forms a hard, protective covering for the seed. Examples of this form of fruit are the cherry, plum, etc. The blackberry and raspberry are formed by an aggregation of such drupes placed on the enlarged receptacle. These are known as *compound drupes,* and each separate fruit is a *drupel,* each drupel having, of course, the same structure as the cherry.

Such fruits as the above are *true fruits,* but let us now notice a few well-known examples in which other parts of the flower go to form the so called "fruit." These are *spurious fruits.* In the first place, let us take the *strawberry.* In this the red, swollen mass is simply the end of the stalk, which has become succulent, while the fruits themselves are the yellow bodies in the surface, which are commonly called seeds, each of these fruits, as we have seen before, being an *achene.* Again, the end of the stalk, or receptacle, instead of bulging out, as in the strawberry, may become hollowed out so as to enclose a cavity in which are placed the fruits. The fig is an example of this. The fig is thus a strawberry which has become, so to speak, invaginated. The type of fruit termed a *berry* is a succulent fruit in which the seeds are imbedded in a pulpy mass—*e.g.,* the *gooseberry* and *grape.* The blackberry, raspberry, and strawberry are therefore not true berries at all. Now let us take the *apple.* This is a still more modified form, as the calyx tube, in addition to the pericarp, encloses the seeds. The calyx tube has become fleshy and forms most of what we eat; the mesocarp also is fleshy; while the epicarp and endocarp form two horny cases. Finally, the most modified fruit is the *mulberry.* Here the group of flowers, the petals of which have become succulent, forms the so-called mulberry fruit. The pineapple is another example of this kind.

These few familiar examples will suffice to show what different parts of the flower go to form what are popularly known as fruits, and also what different parts may become succulent. In the cherry, blackberry, raspberry, etc., it is the true seed case which becomes succulent; in the strawberry it is the swollen stalk; in the apple the calyx tube; and in the mulberry the petals of the flowers themselves.

Now let us consider the reason why some fruits are succulent and others hard; why some are sweet and others bitter; and why some are highly coloured and others dull. The primary object of all fruits is the perpetuation of their species, by means of dispersing their seeds. It is obviously of advantage for the seeds to be scattered over as wide an area as possible, because only a certain number of plants can grow in a certain area. The seeds have no inherent power of locomotion; hence they must avail themselves of such opportunities as occur. The simplest agent in dispersal is the *wind,* and seeds which avail themselves of this means are either minute, so as to be easily blown about, or else they are downy, as in the dandelion, so that they can float a long way in the air. The second means of dispersal is by *animals,* chiefly birds, and such seeds avail themselves of this means which cannot be dispersed by the wind. Animals may cause dispersion of seeds in two ways. Firstly, by carrying earth with seeds imbedded in it in their claws. A good example of this is given by Darwin, who states that he obtained a piece of earth which had been found sticking to the leg of a partridge, and since then had been kept three years, but when wetted and placed under a bell-jar, he obtained no less than eighty-two plants from the seeds imbedded in it. This also shows the length of time that seeds retain their power of germination. Secondly, animals may disperse seeds by swallowing them as food. The seeds of such fruits are protected by a hard coat, which resists the action of the digestive fluids of the animal's stomach, and the seeds thus pass out in the excrement uninjured, and get dispersed during the peregrinations of the animal. Fruits which attain the dispersal of their seeds in this way become as succulent and sweet as possible, and acquire bright colours to attract the birds and other animals; but this does not take place till they are ripe, for otherwise they would be eaten before the seeds were mature. In other words, such fruits strive as hard as possible to get eaten. Take, for example, the wild strawberry; the young strawberry is green and sour, to prevent being eaten till the seeds are mature; when, however, the seeds are attaining maturity, the receptacle becomes red and succulent, to attract the notice of the birds; the latter swallow the pulpy receptacle and with it the small yellow fruits; the receptacle is digested, but the seeds pass through uninjured and so become dispersed by the flight of the bird.

Hence we see the reason for fruits becoming succulent and sweet is in order to make themselves attractive food for birds and other animals, and so ensure the dispersal of their seeds. Such fruits we may call *attractive fruits.* But this explanation will not account for the origin of the nuts or *deterrent* fruits. In these it is the seed itself which is nutritious, owing to the large store of albuminous material destined for the young embryo plant. Owing to this large store of food, these fruits *do not require dispersal,* hence do not make themselves attractive; on the contrary, they make themselves as repulsive as possible, and devote all their energies to prevent getting eaten and to preserve their nutritious seeds, as it is evident that these seeds, since they are digestible, will cause destruction of the species if they are eaten.

These *deterrent fruits* may be protected by a prickly coat, as in the chestnut, or a nauseous covering, as in the walnut; and it is interesting to note that it is the same part that becomes filled with bitter essence in the walnut which in the cherry or plum becomes sweet and eatable. Again, these fruits, instead of being highly coloured to attract the notice of animals, are invariably green while on the tree, and brown, like the soil, when they fall to the ground, so as to escape the notice of the animals. The extent of the protection depends on the animals to whose attacks the nuts are exposed. The European walnut has only a few woodland animals to guard against, while the American butter-nut has to withstand the teeth of the forest rodents.

Take, for example, the *cocoa-nut*. This contains a large store of food-stuff intended for the embryo plant. This accounts for the milk in the cocoa-nut, but not for the fibres on the outside! Let us consider the reason for the presence of these fibres. The cocoa-nut grows at a considerable height, and so has to fall some way to the ground when ripe; also it is subject to aggravated assaults from our revered ancestor, the prehensile ape. This accounts for the presence of the fibrous coat of the nut. It is remarkable to note that the fibrous coat of the cocoa-nut corresponds to the succulent part of the cherry and the bitter coat of the walnut.

Finally, Darwin has shown that there is considerable evidence for believing that the *peach* is derived from the *almond* by artificial selection. This is interesting, as it shows the actual conversion of a deterrent fruit, the almond, into an attractive fruit, the peach.

Lastly, let us consider the *origin of fruits*. The doctrine of natural selection tells us that in uncultivated plants—*i.e.*, plants in a state of nature—no part can be present that is not of direct use to the plant; and, in the case of fruits, no part can be present that is not directly concerned in the preservation and dispersal of its seeds. Hence it is absurd to suppose that fruits were created for man's special benefit, for if man was the chief eater of fruits, the latter would soon disappear from the face of the earth, from insufficient dispersal of their seeds.

The origin of fruits is due to natural selection, and furnishes us with some of the best examples of this law; for, in the case of plants, we at once get rid of the idea of voluntary effort, so difficult to escape in the case of animals; for we are apt to imagine an animal consciously striving to better itself. Take, for instance, the giraffe; we are apt to think of the animal as consciously endeavouring to increase the length of its neck in order to reach more food; whereas it is really those which have *accidentally* longer necks which survive. In the case of plants this is avoided, as we should never imagine a fruit striving to make itself succulent in order to attract birds.

Let us first consider the origin of *attractive fruits*. All fruits were not originally alike; some happened to be sweeter than others, owing to an accidental deposit of sugary matter in their tissues. These were at once eaten by birds, and the more sour ones rejected; the ones eaten consequently survived, and the sour ones went to the wall. The seeds of the ones eaten gave rise to others, which reproduced the characteristics of their parents; and the most attractive of these were eaten, and the others rejected, and so on, generation after generation, the fruits becoming more and more succulent, because the most succulent ones were eaten and survived. This process may be carried still further by artificial selection, so that the original object of the fruit is lost, and fruits can be produced which have no seeds. In this way, finer fruits are produced, as the nutriment originally intended for the seed now goes to the fruit.

We should naturally expect that attractive fruits did not appear on the earth till there were animals which would eat them; both must have developed simultaneously and in mutual dependence on each other. So we find no traces of the succulent fruits, even in so late a geological formation as that of the lias or cretaceous cliffs, for the simple reason that there were no animals to eat them; the birds of that period being carnivorous, while the mammals were mostly kangaroos or marsupial wolves. It is only in the modern tertiary period that we find the earliest traces of the rose-family, the greatest fruit bearing tribe of our modern world.

We now come to the origin of *deterrent fruits*. The origin of these is exactly the reverse of the origin of attractive fruits. The seeds of these, stored with food for the young plant, were exposed to the attacks of birds, monkeys, and other animals, and were thus destroyed. But as no two fruits are exactly alike, some happened to have a harder or more bitter shell, and these alone survived. The hungrier their foes, the more need was there for protection, and so the bitterness and hardness went on increasing generation after generation, and the nut which best survives on the average is that which is the least conspicuous in colour, has a rind of the most bitter taste, and is enclosed in the hardest shell.

Thus, as Grant Allen says, "Nature is a continuous game of cross purposes. Animals perpetually outwit plants, and plants in return once more outwit animals; or those animals alone survive which manage to get a living in spite of the protections adopted by plants, and those plants alone survive whose peculiarities happen successfully to defy the attacks of animals."

Reviews.

Whence Comes Man; from "Nature" or from "God"? By Arthur John Bell. London: W. Isbister, Limited, 1888.

Mr. Bell says in his introduction that he is "only an ignorant person," not possessing "any deep knowledge of theology, philosophy, or science," and pretending to "no more than an average amount of common sense." But we may safely supplement his remarks by adding that he has more than the average amount of courage—to give its noblest name to the quality he manifests—for he has in all his ignorance ventured far into the deepest problems of theology, philosophy, and science, and traversed the conclusions of men who surpass him in knowledge as much as he surpasses them in temerity.

We are sorry that Mr. Bell did not devote himself more earnestly to the serious effort needed for rightly understanding the meaning of the great men he takes to task; he would assuredly have met with his reward, for he seems to be possessed of that degree of intelligence which renders the achievement possible. As it is, he has in many instances misunderstood their meaning, just because "common sense" will no more enable a man to grapple with philosophical or scientific difficulties than it will enable him to navigate a ship or conduct a campaign. For example, he quotes Spencer as follows: "Self-existence, therefore, necessarily means existence without a beginning; and to form a conception of self-existence is to form a conception of existence without a beginning. Now, by no mental effort can we do this. To conceive existence through infinite past time implies the conception of infinite past time, which is an impossibility." On this passage he makes a comment which is nothing less than absurd. "I, that true?" he says. "I can certainly think a fortnight. Does it take fourteen days to 'think' a fortnight? Does it take a longer time to think a fortnight than to 'think' a week; and a shorter time than to think a month? When Mr. Spencer uses the word 'conception,' he is evidently thinking not of 'conception,' but of '*experience*.' Let us change the word 'conception' to the word 'experience.' 'To experience' existence through unfinite past time, implies the 'experience' of unfinite past time, which is an impossibility. Of course it is. But a *conception* of unfinite past 'time' is not. It is simply the thought of time *without* limit, and is simply what I call a 'private' idea, the formation of which presents no difficulty."

Now, all this rigmarole has come about because Mr. Bell has not taken pains to understand exactly what Mr. Spencer and other instructed and thoughtful people mean by the terms they use. Mr. Spencer certainly is not thinking of experience when he speaks of conception, and to change the one word for the other is to make nonsense of what he says. Mr. Bell's failure to grasp the meaning of the passage he quotes has led him not only into this injustice, but into the bewildering and ludicrous criticism he gives. When he began to write about "thinking a fortnight," he should have said, if he wished to parallel Mr. Spencer, that a fortnight necessarily means fourteen days, and that to form a conception of a fortnight is to form a conception of fourteen days; if he had done this he would have seen at once that such a line would lead him nowhere in particular, and he would have given it up. But he does not accurately follow accurate thinking, so his own thinking about it is muddled and confused, and he lands himself in absurdity. As to his remark about a conception of infinite, or unfinite, past time presenting no difficulty, we must say that its audacity would have been more startling had he refrained from showing us that he makes it on the ground that he can "conceive a million" years in *as short a time* as he can "conceive a moment."

Again, he quotes Mr. Spencer as follows: "To say that space and time exist *objectively*, is to say that they are entities;" and he comments—"On the contrary, it seems to me that only one of them—'space'—is 'objective,' and therefore an entity; while 'time' is the name of a thought, and therefore 'subjective.'"

Surely even common sense might have saved poor Mr. Bell from this blunder! Mr. Spencer quite plainly states that *if* space and time are *said* to exist objectively, then such an assertion is equivalent to saying that they are entities; whereupon Mr. Bell dashes at him headlong, and attacks a wholly imaginary statement to the effect that both *are* objective, and therefore entities.

After a long attack, conducted mainly on the principles displayed in the above examples, it is not a surprise when Mr. Bell tells us that it seems as if Mr. Spencer "could write hardly a line which does not provoke dissent." There is a well-known piece of advice which we cannot forbear passing on to Mr. Bell; it is a warning that when very obvious objections and very easy criticisms present themselves to the mind in dealing with the work of any man of great and special knowledge, it is the part of wisdom to stop and ask one's self one or two questions. Mr. Bell has not asked himself those questions; he has not played the part of wisdom. This is a pity, for he is capable of doing good work himself if he will only wait until he has learnt to understand other people's. In the book before us he has done bad work; he has wasted his own powers, and tried his best to dim the lustre of some of the greatest names of the age. Happily, his endeavour is ineffectual; but we fear that this foolish attempt to make common sense supply the lack of knowledge may give him a false conceit of knowledge which will render of no avail all his intellectual vigour. It can hardly be anything but this false conceit of knowledge which has led him to the astounding conclusion—the drift of his book—expressed in the statement of his belief that *Space* is *God*.

Proceedings of the Institution of Engineers and Shipbuilders in Scotland. Thirty-first Session, 1887-1888. April 24th.

The most important paper read was one by Mr. Lawrence Hill, on "Collisions at Sea; How to Avoid and How to Minimise their Disastrous Results." An incident mentioned deserves general publicity. That gentleman, an underwriter, told him that he was going to the Mediterranean on one occasion, and with him as fellow-passengers were two ship masters, who ridiculed the captain in charge of the vessel for his cautious navigation—one of them in particular for the captain's extreme caution in keeping clear of dangerous headlands, and the other laughed at him for giving so much searoom to a coming vessel. His friend made a note of these two masters' names, in order to trace their future career, and it was remarkable that the one lost his ship on the very rocks which he had laughed at the captain for giving a wide berth to, and the other's vessel was lost by collision near the place.

Journal of the Society of Telegraph Engineers and Electricians. Vol. xvii., No. 73. London: E. and F. N. Spon.

This issue gives an account of the proceedings at the 177th ordinary general meeting of the Society. The time was chiefly taken up with a discussion on Mr. Crompton's paper on "Central Station Lighting."

Mr. E. G. Tidd read a paper on the "Use of Electricity for Theatre-Lighting." Here he calculated that the decorations would last three times as long when the electric light was employed as under the old system of gas. He states that of the London theatres and music-halls lighted by electricity six work from the Grosvenor and four have their own plant.

Physical Apparatus for Beginners.—A firm in Dresden offer three sets of apparatus—for galvanic electricity, for influence-electricity, and for acoustics—at the remarkable low price of twenty shillings each. The first of these sets contains two Daniell elements, two carbon plates for fitting up Bunsen or chromic acid elements, a galvano meter, a Wheatstone bridge, an electrometer, an induction coil, a permanent bar magnet, a resistance equal to 1 ohm, two thermo-elements, two connecting clamps, and six metres of covered copper wire. The instruments are small and simple, but they are well constructed and work perfectly.

Abstracts of Papers, Lectures, etc.

NORTHERN INSTITUTE OF LITERARY AND SCIENTIFIC SOCIETIES.

The first meeting of this Association was held at Huntly on the 14th inst. Mr. Charles Proctor read a paper on the "Composition of the Atmosphere in the Early Geological Epochs." He pointed out that while all the solid and liquid portions of the globe were chemical compounds, the atmosphere was mainly composed of two free elements, these being the remains of the elemental gases out of which the earth had condensed. Water, probably one of the last combinations, would, when first condensed, be exceedingly hot, and would thus act with much greater force as a disintegrating agent than in its present form, especially in presence of much carbonic acid gas. Thus the character of such rocks as granite, gneiss, and metamorphic rocks could be accounted for. Mr. Proctor then proceeded to point out that independently of this theory of the evolution of the earth there was evidence of there having been much more carbonic acid in the atmosphere at the close of the Silurian and Devonian eras. Pointing out that coal was only the remains of ancient forests, and that these could only obtain their carbon from the carbonic acid gas in the atmosphere, he gave figures showing that even the workable coal known to exist in the world must have required 45 billions of tons of carbonic acid to produce it. And this he reminded the meeting was only a small proportion of the remains of actual vegetation now buried in the earth's crust. Turning his attention next to animal remains he pointed out that probably the bulk of all limestone rocks were originally the shells of living creatures, and that these had been enabled to leave such remains only through the agency of the same carbonic acid. At all events the great chalk formation of Europe was such, and these he calculated, quoting Sir C. Lyall's description of them, must have required 50 to 60 billions of tons of carbonic acid gas, which, added to that from the coal, gave at least 100 billions of tons—a quantity 40 times greater than is now found in the atmosphere, and this was only a small portion of the whole quantity that must at one time have been present. In such an atmosphere, even without the higher temperatures, disintegration and deposition of new rocks must have gone on at a much greater rate than in the present age.

Dr. J. O. Wilson, Huntly, contributed a short paper dealing with "Salmon Disease." The disease referred to was the fungus disease, which has attracted so much attention within the last ten years. It first assumed serious proportions in the Eden, in Cumberland, in 1877, and since that time has visited most rivers in the United Kingdom. In the Deveron it was worst in the autumn and winter of 1883-84; but has since abated. Dr. Wilson then gave a *résumé* of the character and course of the disease, pointing out that it began on the parts uncovered by scales, and afterwards spread to the rest of the body, destroying large areas of tissue by ulceration. The immense number of the spores that spread the disease was also pointed out, and the consequent helplessness of man in endeavouring to stamp out such a disease, Nature's remedy, sea-water, being the best and most efficacious, if the sufferer can only reach the healing waters.

SOUTH LONDON MICROSCOPICAL AND NATURAL HISTORY CLUB.

At the June ordinary meeting of this Club, the evening's gossip was opened by the President, Mr. Frederick Hovenden, who drew attention to the interesting phenomena presented by a thin film of water under the microscope. The film might be obtained by simply breathing on the blade of a knife, when the steam would condense and the disappearance of the water could be observed with a half-inch power. As the globules evaporated, they appeared to leap into the air, the actual point of final disappearance, however, being difficult to detect. Some curious questions as to molecular action were raised by this experiment, as well as by those which he suggested should be made in connection with thin sections of iron. In testing this metal for commercial purposes, a tension strain was used which caused the iron before it broke to ribbon out with considerable heat. Steel under a similar tension made a clear fracture without thinning out and without heat, and this was remarkable, as the tension required to break the steel was greater than in the case of the iron. He believed that if thin sections of iron were made, they would be found full of pores, whilst in sections of steel there would be but few. His theory was that the minute gaps were filled with air, and that the effect of the intense tension was to compress these spaces, thus generating the heat, which was immediately taken up by the iron with a consequent increase of temperature.

Mr. Suffolk observed that some years ago Mr. Sorby had worked out the subject of sections of iron and steel. He had viewed them as opaque objects, having been unable to obtain transparent sections, as the metal would not hold together. Gold would, however, do so, and transmitted light of a greenish tint. With respect to the pond-life exhibited, Dr. Hudson had taken *Brachionus* as the type of a rotifer, and a beautiful drawing of it was given in his work, with an account of its anatomy. The growing slide, Mr. Suffolk said, was not sufficiently used by microscopical observers. If they would only take u the life-history of a diatom, and trace it from its cradle to its grave, many of the so-called species would be found to be but different conditions of the same organism.

Mr. Dadswell explained that the exhibits he had brought to the meeting had all been collected in the neighbourhood of Epping Forest, within an hour's ride from the City. Volvox, stentors, corethra, brachionus, and the more unusual forms, were easily obtained in the locality he had visited.

A specimen of *Melicerta ringeus*, from Clapham Common, was exhibited by Mr. Neville, who stated that within the last few years the water-life of the Windmill Pond had considerably altered in character. Some years ago the pond literally teemed with the crowned rotifer, *Stephanoceros eichornii*. This had now disappeared, but in its place the brick-making *Melicerta* had sprung up, and might be obtained on the scanty vegetation that had managed to survive the building operations in the vicinity.

Mr. Oakden gave some interesting particulars with reference to the hydrachnidæ. The specimen under his microscope belonged to this species of water mite, and was a female. Only those acquainted with the subject were able to determine the difference of sex. The males were fewer in number and of a pale colour. About 40 different species were known of these arrennui, but only a small number were mentioned in the works of English writers. The larvæ had six legs, which were increased to eight on their attaining the adult state. After passing the larva stage the nymph was supposed to be parasitic on some of the water-beetles; but so little was known as to this that both the *Hydrachna*, or scarlet mite, and the *Limnesia*, or bog mite, afforded scope for practical and interesting work. The larva of the *Gyrinus*, a beautiful object, with branchia similar to the may-fly, would also repay observation. It kept close to the bottom of ponds, and was therefore not readily met with.

The president recorded his observations of an amæba, which divided into two parts. These eventually again joined and formed one animal.

Mr. Groves stated he had at first experienced difficulty in keeping chara for continuous observation, a temperature of over 70 degs. being fatal to the plant. By placing it in a very cool place, however, he had found it live and thrive. Having felt the difficulty of dissecting under the ordinary microscope, in which everything was reversed, he had adopted Mr. Stevenson's binocular, a form of which he exhibited, with large rests at the side for steadying the hands.

In reply to Mr. Sebastian Davis, who thought it desirable attention should be directed to the causes governing the group of special forms in different ponds, Mr. Groves stated it was interesting to watch the gradual development of vegetation in the pools of water that formed in newly-opened gravel pits. During the first year little else appeared than confervoid algæ; in the second, chara or nitella would be found; in the third, the water buttercup perhaps made its appearance; then some of the filamentous-leaved water plants, the chara or nitella being completely ousted from the pool; whilst the last to appear was the pond weed, with its flat leaves resting on the surface of the water. He presumed that with this succession of plants there was also a corresponding development of animal life.

THE ARTIFICIAL REPRODUCTION OF VOLCANIC ROCKS.

Translation of a Lecture Delivered by M. Alphonse Renard, LL.D., at the Royal Institution.

At first sight the study of the earth's crust appears, if one may so express it, entirely utilitarian. It almost seems as though it were absolutely forced on man by the necessity of exploring the strata of the earth for the purpose of extracting minerals, building materials, combustible matters, etc.

It is evident to anyone who casts a glance at the history of any of the sciences, that these sciences owe their origin in the first place to a definite, practical, and useful aim, that they have all passed through this initial phase, and have afterwards followed a regular development, the progress of which, as concerns geology, we will here endeavour to trace.

Man commences the exploration of terrestial depths in order to draw from them the materials necessary to supply his several wants. At first he does this at haphazard; but, as the miner's art develops, the search for mineralogical treasures is carried out with more method—he begins to observe the conditions under which minerals and useful rocks are found in close proximity in the depths of the earth. He does not hesitate to generalise from his observations and from the localities in which these rocks are found, and thus discovers the salient points of the architecture of our globe. In excavating into the bowels of the earth, one is forcibly convinced that the globe was not made at one fell swoop but owes its formation to successive epochs.

It is clear, therefore, that to rightly interpret the history of the earth, and the part played by various causes in its formation, it is necessary to make exhaustive studies of the solid crust, so as to be able to picture the state of our planet in past ages. By comparing the different strata of the globe with the formations which are developing before our eyes, we can succeed in retracing the conditions which were the chief agents in the formation of the layers of ancient periods. Thus, by the analysis of facts and the induction from generalised observations, the knowledge of the earth's crust enters into a new and truly scientific phase. The original attempt to discover some practical rule for the miner resolves itself gradually into a desire to unravel the history of the earth. A fundamental principle guides us in this reconstruction of the past of our planet—the fact that the essence of the forces which have acted upon the earth still remains unchanged. We must seek in geological epochs for the traces of those phenomena only whose nature is akin to that of phenomena which we ourselves witness, and which we can submit to critical direct observation. A vast number of documents on the history of our planet has accumulated since the latter end of the last century, when the inductive method was first applied to the study of the mineralogical masses forming the crust of the globe, to their architecture, and to the beings whose remains are fossilised in the different layers.

Let us see how, relying on this induction and putting this analytical method into practice, geology interprets the formation of rocks. Rocks are, as we know, the solid mineral masses which constitute the strata. Observation teaches us to distinguish a first group, characterised by the disposal in layers or in beds; these are sedimentary rocks. A second group, which does not show this stratified disposal, includes the rocks of a volcanic nature and massive structure. The widely-differing structures and compositions of these two great lithological divisions, lead us to the conclusion that they were formed under special conditions which have left their distinctive marks on each group.

The formation of the sedimentary rocks is at once understood if we observe how both river and marine currents deposit on their beds pebbles, sand, clay, etc. As the organisms living in these waters die away, their skeletons or their shells mingle with the mineral substances, and, with these latter, gradually raise the layer of sediments. The matter thus deposited naturally takes, from the manner in which it accumulates, a stratified appearance. All the particles of which these layers consist were originally isolated grains, and still bear traces of their origin; they are the remains of organisms, or the fragments of pre-existent rocks, which will subsequently all be unified again by physical and chemical action.

Now let us compare these modern sedimentary deposits, characterised by their stratified disposal, and the detrital nature of their constituents, with certain layers of geological formation. We see, on the surfaces of continents, masses owing their formation to geological periods, which present close analogies of aspect and structure with the materials which are deposited before our eyes by river and sea-water. This comparison leads us to suppose that the ancient stratified rocks were formed under identical conditions, and we accept them as sub-marine or fluvial deposits. Thus water is the main agent in the formation of sedimentary and detrital masses.

The second group, to which we will now give our particular attention, includes the rocky masses. Types of this group we can observe in process of formation during volcanic manifestations. The molten matter ejected by the crater, or injected into the sedimentary layers, solidifies as it cools. The minerals which constitute the lavas are individual crystals developed in the molten magma in which they are contained. These crystals present no detritus in the sense that we now attach to this word. Broadly speaking, these eruptive masses do not show the stratiform tendency of the sedimentary formations; instead of the primitive horizontality and the regular superposition of the stratified layers, we have in the lavas an aspect which clearly proves the forces of upheaval from below to which they are subjected at the time of their eruption. Finally, these massive rocks bear no traces of animal organisation.

Let us compare, in their turn, the contemporary volcanic products with certain ancient crystalline rocks—the granites, porphyries, trachytes, basalts. We notice that all these latter possess close analogies of structure and composition with the products of modern volcanic activity. From this resemblance of their common characteristic features, we may conclude that the massive rocks which traverse the sedimentary geological formation were, at first, like the modern lavas, forcibly upheaved from below, and that they share with these lavas an eruptive origin.

But while we may see the sedimentary rocks formed almost before our eyes, the conditions which influence their formation, carried out, as it were, in broad daylight, the eruptive masses are elaborated in the innermost recesses of the earth. Their genesis is, to a certain extent, surrounded by mystery; the eye cannot penetrate into the vast subterranean reservoirs where these molten masses first solidify, and whence they are ejected at periods of volcanic activity. Here the process of direct reasoning is rendered practically impossible; the finest analysis, the closest reasonings cannot replace the missing data—they are powerless to fully enlighten us as to all the causes at work in the formation of eruptive rocks.

To resolve our doubts, control and complete our observations, we must have resource to an artificial reproduction of volcanic rocks, and thence form a synthesis. Armed with the data of such observations as we have to act as guide, we endeavour by scientific manipulation to imitate the results of nature. The science of the earth, hitherto analytical, thus enters on a new phase and becomes synthetical. Although restricted by the available apparatus, these endeavours to imitate nature, originated and conducted by man's intelligence, enable us to produce results analogous to those which we wish to investigate, to direct and watch over the progress of the phenomena, to obtain an exact account of their relations to each other, and to vary at will the conditions under which they arise. The knowledge acquired by observation, the analysis, and the reduction are thus all, to use Bacon of Verulam's expression, "submitted to the iron and fire of experience."

We have given, in broad outlines, three standpoints in the onward march of the knowledge of the earth's crust. We have seen it at its earliest stage, when its aim was purely utilitarian, we have followed it later; when, guided by observation and reason, it rose to the dignity of a science. Geology, in its last phase, is, at the present day, transformed into an experimental science.

The study of the recent artificial reproduction of volcanic rocks amply proves the powerful assistance rendered by laboratory research to observation taken direct from nature. But before explaining the process of the synthesis of contemporary eruptive rocks, we must sum up all that analysis and the observation of facts have taught us on the constitution and mode of formation of these volcanic masses. The point of comparison of the synthesis is to be found in the natural lavas—they are the models which we wish to reproduce, and it is therefore necessary to thoroughly understand them in order to successfully imitate them in minute details.

Let us reconsider, then, what we know about these lavas and the conditions which influence their formation, although we cannot pause here to contemplate the great manifestations of the internal forces of the globe, nor the trains of accompanying phenomena—the formidable eruptions which shake the volcano to its very foundation, and project pulverised vitreous masses and red hot stones. In the middle of this disturbance the crater and the flanks of the mountain, fissured by the force of the upheaval, emit streams of molten lava which roll down the slopes and slowly solidify.

The chief feature of an eruption is the emission of lava or stream of molten matter which escapes from the crater. Broadly speaking, one may best compare this lava to glass liquefied by the influence of the high temperature which predominates under the solid crust of the globe. Direct observations of the temperature of the liquefied lava of the crater, made at the moment of its eruption, are fraught with dangers such as few observers care to face. Thus we possess on this point only approximate indications, although on some volcanoes where the expulsion of lava is never very energetic, but which are permanently in a state of moderate activity, as in the Island of Hawaii, it is possible for intrepid scientists to approach sufficiently near to the crater to attempt to estimate the temperature of the liquid mass. They have thus been enabled to average it as varying between 1,000° and 2,000°. But from the moment the lava begins to flow, the temperature of the surface rapidly decreases; the sheet of liquid is covered with a crust of scoriæ, beneath which the molten mass flows on like a stream, at about the temperature for melting steel. This mantle of scoriæ prevents irradiation, and enables the mass which it covers to preserve for some time a certain amount of viscosity.

A little later we will discuss the observations on the phenomena of the crystallisation which occurs in these erupted masses, still fluid and viscous, but on the verge of instant solidification. Let us consider, first, some of the essential characteristics of the structure and composition of the lava. These volcanic products are often full of bubbles (scoriaceous); sometimes, on the contrary, they appear as homogenous, glassy masses, more or less dark in colour, in which the naked eye can detect no isolated minerals. Sometimes, again, the mass is so full of minerals that the glassy paste which unites them is scarcely recognisable. The minerals thus imprisoned, when their development is perfect, present regular polyhedral forms, constant for each specimen—that is to say, they are crystals, perfect individual specimens of the mineral world. They have extracted from the primitive glassy mass the chemical elements of which they consist, and which group themselves according to their several affinities, just as we see, in a liquid saturated with a solution of salt, crystals reforming the substance of which was previously dissolved in the mother liquor.

Mineralogy teaches us to define the different kinds of minerals which crystallise in the lava, whilst chemical analysis furnishes us with valuable information about the composition of volcanic products. If we treat eruptive rocks by a chemical process, we find that they all contain a more or less considerable quantity of combined silicate, which sometimes amounts to even 65 % of the whole mass; these are acid or light lavas. Thence we pass by various transitions to basaltic and heavy lavas, in which the amount of silica, gradually diminishing, does not attain to more than 55 % or 45 %. This silica does not exist in a normal state in contemporary lavas, but is combined in the form of silicates, with aluminium, iron, lime, magnesium, potash, and soda.

We find in the slag of metallurgic industries products which bear close analogies to those of volcanoes, both in composition and formation. These artificial scoriæ are, like the lavas, formed of silicates, and a still stronger similitude lies in the fact that the lava scoriæ may be considered as the dross of the internal metallic nucleus, of which they form the upper layer. The differences which we find in their compositions result from the greater or less depths of the zones whence they are taken.

Our knowledge of eruptive rocks has been increased to an unlooked-for degree by the application of the microscope to lithology. We have no space here to record all the almost marvellous results obtained by this method of investigation, inaugurated by H. C. Sorby, but, to put it tersely, microscopical analysis has completely revolutionised the study of stones.

(*To be continued.*)

THE NEW YORK STATE ENTOMOLOGICAL STATION.—The building erected at Cornell University consists of two parts, a laboratory and a vivarium. The former includes a laboratory for the experimenter and his artist, a laboratory for an assistant, a room for photographic work, quarters for janitor, and a storeroom. The vivarium is in the form of an ordinary botanical conservatory, sixty feet in length, divided by a transverse partition into two equal compartments. One of these is to be used as a hothouse, the other is to be kept as nearly as possible at the temperature of the air outside. This vivarium is to enable the experimenter to keep the insects that he is studying alive upon growing plants where all the conditions can be controlled. An arrangement has been devised by means of which insects living upon roots of plants can be observed continuously without disturbing them. Another is to aid in the study of the relations between ants and plant-lice. Others are for experiments in the use of insecticides.—*American Naturalist.*

RE-FORESTATION IN AMERICA.—Professor Willitts, of the Agricultural College of Michigan, believes (*Popular Science Monthly*) that the moisture on the American continent is advancing westwards, and that the planting of forests will cause the rainfall to spread year by year further to the west. In Nebraska 700,000 acres of forest have already been planted—the cotton-wood and the willow first, and then the soft maple and the hard woods.

THE HEARING OF FISHES.

CAN fishes hear?

That is a question which must be variously answered, according to the sense in which it is propounded. If it be asked whether they hear at all, we must unhesitatingly reply in the affirmative. If information be sought as to whether they hear as we do, our decision may as unhesitatingly be given in the negative. And, thirdly, if it be suggested that, while submerged in the water, they can distinguish sounds in the air, we must treat the proposition as one open to considerable doubt. And to these three points let us now devote our attention in turn.

Do fishes, then, hear at all? We may reply, as already stated, without a moment's hesitation, that they do. For in them we find the first rudiments of the auditory organs which attain to such perfection in the higher vertebrates; and in many cases, to use a somewhat Hibernian expression, these rudiments are present in a fairly complete state. And the very character of the organs of hearing is such that, even in their most incipient stages, they must necessarily be of more or less value to their owner. One cannot imagine the work of evolution going on in any sensory apparatus if the actual practical utility of such apparatus were to be delayed until development were complete. The organs, upon such a supposition, would be of no possible value to their possessors while still rudimentary, and so would have no chance of preservation, still less of gradual development and perfection. And thus it seems evident enough that the mere presence of an auditory system, however incomplete, must imply that the sense of hearing is at least not wholly wanting.

It is true that fishes possess neither external ear, Eustachian tube, nor tympanic cavity; but that affords us no proof whatever that they do not hear. Water is so much more dense a medium than air that its vibrations are and must be carried to the brain of any animal submerged therein, whether that animal possess ears or no. And the internal ear in the fish is so formed that any such vibrations must be keenly felt and appreciated, although of course not in the same degree as in animals whose sensory apparatus is more perfectly developed.

But in no aquatic creatures do we find the external ears of any great dimensions. In the whales and the seals those organs are almost microscopical, in proportion to the bulk of the body. In certain semi-amphibious animals (I use the adjective in its popular sense) they are so formed that they close instantly upon submergence, and remain practically non-existent until the head is raised from the water. And the reason is evident enough. Water, as a denser medium, transmits vibrations with so much greater intensity than air that a submerged animal possessing ears adapted for the reception of atmospheric sound would be literally stunned by such a shock as that resulting from a heavy blow upon the surface. The North American Indian, walking over a frozen river in mid-winter, sees a beaver swimming below him, and immediately brings down his club with all his force upon the ice. The shock is borne to the water, and through the water to the brain of the beaver, which, stunned by the concussion, is drawn out through a hole hastily cut in the ice before it recovers its senses. Were a whale gifted with ears corresponding in size to its bodily dimensions it would probably be killed by the shock resulting from the first blow of its own tail upon the water; seals in the same way would suffer greatly from their own evolutions, and from those of their comrades. And any one who wishes to test for himself the qualities of water as a conductor of vibration can do so by submerging himself two or three feet, and allowing a companion to strike with a stick or an oar the surface immediately above him. The experiment is one which he will not find it necessary to repeat.

Whether fish can appreciate sound, as we understand the word, is another question altogether, and one which can be almost certainly answered in the negative. For sound, in our ordinary acceptation of the term, is an atmospheric phenomenon only, and cannot be transmitted from the lighter medium of air to the denser medium of water. Let the sceptical reader again dive a foot or two beneath the surface of a pond, a stream, or the sea, and he will find that sounds in the air above are perfectly inaudible. A companion may shout or sing, or even fire a gun, and he will hear nothing whatever so long as the water itself be not disturbed. How, then, can we hold that fish hear atmospheric sounds, seeing, moreover, that they possess no external ears whatever, and that even the internal auditory apparatus is so very far inferior to our own? Vibration, even of the water itself, must necessarily reach them with greatly diminished intensity: and how is it possible for them to succeed in hearing sounds which to animals with senses far more highly organised are, and must be, perfectly inaudible?

But how, it may be asked, are we to account for the many reports of fishes recognising the sound of a bell, the blast of a bugle, or the shrill call of a whistle, and hastening to the accustomed feeding-places in anticipation of food to follow? Stories more than one of such a character have from time to time been given to the world, and backed, in some cases, by quite unimpeachable authority. How is evidence such as this to be set aside?

Again the explanation is obvious enough. In one at least of the instances referred to, and in that which is best authenticated, the custodian of the fish was invariably accustomed to drive to the reservoirs in a tolerably heavy cart; and it is evident enough that the sound which brought the fish to the feeding places was not the stroke of the bell by which they were apparently summoned, but the vibration caused by the wheels, which was conveyed through the earth to the water. Sound cannot be communicated from the lighter medium to the denser, but from the denser to the lighter it can. And the rumbling of a heavy cart would certainly be quite audible to fish in a neighbouring pond or stream. Even a heavy footstep near the bank will frighten the fish lying beneath it, as many an angler has discovered to his cost; he who wishes to capture them must tread lightly, in addition to keeping himself concealed. The vibrations of a heavy bell, again, might possibly be transmitted to the earth through the body of the ringer, and from the earth to the water, and so to the fish. And in none of the cases referred to does any precaution seem to have been taken to prevent the fish from discovering the presence of their keeper by other means than that of atmospheric sound. Even an approaching footstep, to fish born and bred in captivity, would be sufficient to attract their attention: and as by long association they would connect such a footstep, coming at regular intervals, with the supply of food, it is hardly to be wondered at if, on hearing it, they should manifest the eagerness and excitement described. But we cannot hold that they hear either the whistle or the bugle, or even the footstep in the ordinary manner. No impression whatever would be conveyed to their auditory organs by the former; the latter would communicate vibration to the soil—which is an excellent conductor of sound—and the earth in turn would pass it on to the water. And so it would reach the fish.

But the appreciation of vibration conveyed in such a manner, and reaching the brain without passing through external auditory organs *en route*, is not hearing in the strict sense of the term; it is merely the shock arising from a veritable blow, differing only in degree from that which stuns the beaver as he swims along below the ice. And thus fishes, in the ordinary interpretation of the term, do not hear. Such auditory apparatus as they possess, however, enables them to appreciate with greater nicety vibrations which would probably be in some degree appreciable had they no such apparatus at all; they can detect sounds in the water without difficulty, and sounds in the earth, if not too far from land, with tolerable ease. But sounds in the air, it is not too much to say, they cannot hear at all, unless in some way associated with, or implying, a corresponding concussion of the water.

A BIG THING IN GUNS.

FOR two or three years past the subject of heavy ordnance has engaged the attention of public men, and the question whether the old style of built up cannon could be superseded by others solidly cast has been discussed in all its bearings. At last the matter got into Congress, and, in March, 1887, twenty thousand dollars were set aside for the purchase of solid steel guns, provided that they could be made.

Bids were asked from the different steel men in the country for the production of a cast steel gun made by either the crucible, open hearth, or Bessemer processes. It was expected that there would be a very general response to this invitation. On the contrary, only two bids were received—one from an open hearth concern in Eastern Pennsylvania, and the other from the Pittsburg Steel Casting Company.

The contract made by the manufacturers with the Government called for the delivery of the gun in Washington ready for rifling on or before the 1st of April. Then the Government allows itself seven months more before expressing its opinion as to the merits of the gun. Three of those months can be spent in finishing the gun, and the other four in testing it at Annapolis.

Appreciating to the full the importance of the work he had undertaken, Superintendent Hainsworth's preliminary steps were characterised by the utmost caution. There must be no mistake about the quality of steel used, and its component parts must be judged with undoubted accuracy. A long familiarity with the metal enabled him to manufacture it with just the particular qualities he required for his work. Before doing this, however, the mould for the gun must be prepared. A pit, twenty-five feet deep, was dug in the moulding shop within easy reach of the great converter, and in this was made the mould. A special sand was used, and soon the exact shape of the exterior of the gun, muzzle down, could be seen in the pit.

By January everything was ready for the cast. The mould was carefully inspected for the last time, and sixty men lent their assistance to the process of pouring the white molten steel into the pit. The immense converter ceased its roaring as it turned over, the infernal stream poured forth, and in little more than sixty seconds the mould was full. The metal was poured into a "gate" or pipe that ran to the bottom of the mould, so that the steel entered the mould at the bottom and welled up to the breech at the top.

For half an hour there was nothing more to be done. Then the pit was surrounded by anxious faces, and the superintendent, his eyes shaded, peered into the hole. His long experience in steel making enabled him to take in at a glance many signs of success that would have been hidden from any one but an expert, and he pronounced the "cast" a success as far as it had gone. As to the quality of the steel he must wait for it to cool before he could give an opinion. The total length of the casting over all was $276\frac{3}{4}$ inches. The sinking head, which was made in two diameters, was 72 inches in length. The part immediately above the gun, which was 48 inches long, was $16\frac{1}{2}$ inches in diameter at the top and 17 inches at the gun. The smallest section, which was 2 feet high, was 15 inches in diameter at the bottom and $14\frac{1}{2}$ at the top.

The finished length of the gun will be 193·53 inches, the total weight of the metal 18,490 pounds, the length of the pattern for the gun proper being $204\frac{3}{8}$ inches.

The gun was in the mould five days. At the end of that period it was cool enough to be removed. A very thorough examination of it was then made, every inch of its surface being closely inspected, and several pieces cut off the sinking head for chemical tests. Not a flaw could be found, and the experts who were permitted to examine the gun declared it to be a perfect piece of Bessemer.

The next process was the rough boring. The solid cone was placed in a lathe, and a tool of the finest steel began to cut a tunnel through it, beginning at the muzzle. The bore was $5\frac{1}{4}$ inches in diameter. For over a week the tool went through the hard steel, the turnings being carefully preserved and tested at intervals.

These tests showed the steel to possess in a remarkable degree the qualities which are essential The result of a test made upon a piece of the metal cut from the angle of the trunnion showed :—Ultimate strength, 92,700 pounds; elastic limit, 51,960 pounds; elongation in 2 inches, $12\frac{1}{2}$ per cent. Samples taken during casting under cold bending tests, gave the following results :—Pieces forged from 2-inch square ingot to $\frac{5}{8}$-inch square, and allowed to cool, were bent cold to an angle of 161 degrees without fracture.

As the bore was cut through it was carefully watched, an incandescent electric light bulb being used to examine the interior of the gun when the cutting tool was withdrawn. Two or three hours was sufficient to dull the edge of the tool, and it had to be taken out and ground at frequent intervals. The time when this became necessary was unerringly indicated by the heating of the gun caused by undue friction. At last the bore was cut through, and nothing but satisfaction could be expressed. The Government inspectors were at the mill every day, and it is safe to say that the big gun received as close attention as any mother vouchsafed to her first babe.

Now came the annealing. This was a delicate operation, and upon its results depended very largely the success or failure of the gun. A bricked up furnace, deep enough in the ground to enable the gun to be placed in it muzzle downward, with but a few feet above the surface, was prepared. Into this the gun was carefully lowered. Then it was slowly heated by natural gas to a temperature of 1,400 degrees, allowed to cool, again subjected to the 1,400 degrees, and again allowed to cool. It was in the annealing that Mr. Hainsworth made his boldest departure from the accepted methods of preparing steel for trying work. In talking about it the other day he said :—

"We do not use the old-fashioned oil tempering process. Oil tempering has been tried in England, and it is an open question whether oil does or does not temper steel. By our process we can give the steel used in the 'chase' or barrel of the gun ductility, and that in the chamber excessive toughness. Steel guns tempered with oil are liable to develop weakness in the 'chase.' We have our process thoroughly under control, and can give the steel special physical characteristics as required in different parts of the gun. Thus, in the 'chase,' we want ductility supremely, while in the chamber tensile strength and elasticity are mainly required."

The claim made by Mr. Hainsworth for his annealing method was thoroughly borne out by the result of the process in connection with the gun. In about a fortnight from the time it was placed in the annealing furnace it was taken out and placed in the lathe once more. Scarcely was it secured when workmen attacked the test pieces around the trunnion with cold chisels. The resistance of the metal to the chisel was greater than the men had ever experienced before, and many were their admiring comments as they chipped and chipped away. It needed but a superficial test of the pieces thrown off from the trunnion to show experienced men that the steel was as tough, close, and smooth as could be desired. The men next went to work at the breech, cutting off a portion of the sinking head to be subjected to official tests in Washington. Ere the test piece was quite severed from the breech Lieutenant Eaton, the Government Inspector, placed his mark upon it and authorised it to be cut off.

At Washington it will be rifled, polished, and made ready for the firing tests at Annapolis. There will be no child's play, and the gun will not be humored in any way. It will be loaded up with a one hundred pound ball and as much powder as can be forced in at the breech and touched off. This will be repeated as fast as the gun can be charged. Ten shots in eleven minutes is the rate at which it is expected the gun will be fired. The contract requires that the ball shall travel at the rate ef 2,000 feet a second as it leaves the muzzle, and, to attain this velocity the pressure upon the gun will be tremendous. If the gun is as good as its maker believes, it will stand this ordeal without a sign of weakness. It is tested to stand a pressure of fifteen tons to the inch at the breech and five tons to the inch at the muzzle.

Supposing that the gun passes the regulation test satisfactorily, it is expected that it will be put to still severer tests, each one greater than the last, until it blows to pieces. The gun will be lost, but it will convey a lesson in the manufacture of heavy ordnance that it is hoped will be worth millions of dollars to the people of the United States.

The contract price for this gun, which will be paid only in the event of its withstanding all tests, is 3,300 dols. A built-up gun of the same calibre would cost 22,000 dols. These figures speak for themselves, proclaiming unmistakably the revolution in gunnery that will take place if solid steel cannon become the ordnance of the world. —*New York Herald.*

CORRESPONDENCE.

The Editor does not hold himself responsible for opinions expressed by his correspondents, nor can he take notice of anonymous communications. All letters must be accompanied by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

METEORITES AND LIGHTNING.

At a recent meeting of the Royal Meteorological Society a paper was read on "The Non-existence of Thunder-bolts," in which it was sought to demonstrate that the fall of material substances during thunder-storms, as being in any way connected with the same, was a fallacy—a sophism that should be relegated to the myths and superstitions of the past.

I think, however, that there may be reasons for connecting the two phenomena, and that a thunder-bolt, meteorite, aërolite—or whatever we may choose to designate the falling substance—may occasionally be *permitted* to reach the earth by the aid of an electric discharge.

Recent researches have shown that about four hundred millions of telescopic meteorites enter our atmosphere daily, and become dissipated into vapour on reaching that part of our aërial envelope which is sufficiently dense to raise the temperature of these supramundane bodies to vaporising-point.

The pressure of our atmosphere at sea-level equals about $15\frac{1}{2}$ lbs. per sq. in., but, as the increment of elevation arithmetically progresses, so the decrement of density and pressure geometrically progresses; thus, at three miles the pressure is reduced to about $7\frac{1}{2}$ lbs, while at six miles it is but little more than $3\frac{1}{2}$ lbs.; beyond this height it must rapidly graduate into an etherial substance of extreme tenuity; hence a meteorite travelling towards us would meet with continually increasing resistance owing to increasing speed and increasing air density, so that the nearer it approached the earth the less likely would it be to reach it.

From the results of the observations made by Ekholm and Hagström, at Upsala, we find that clouds attain a higher altitude than was formerly supposed. The highest cirrus clouds observed reached 41,000 ft., the numerous other types being found at varying distances below this. It was also observed that the summits of cumulus clouds attained their greatest height *during thunderstorms*, the bases of the same remaining nearly always constant.

It is supposed that clouds at a height of five miles consist of crystallised water, and that the intense cold of such high altitudes as 20 or 30 miles probably reaches 100° C. below freezing point.

From the above facts we may, I think, infer that certain supramundane bodies are drawn towards the earth without undergoing any change through friction or air-compression during the first part of their journey; let us assume also that during the second stage the heat generated by an increasing density of air would be counterbalanced by the intense cold and clouds of frozen moisture, it must be apparent then that after this stage the most formidable barrier would remain in the shape of a rapidly-increasing density and temperature.

In this last zone would be found a critical point, upon the reaching of which the previously uninjured meteorite would become incandescent and disappear.

(I presume this critical point would vary considerably, depending, of course, upon the nature of the meteorite and the state of the surrounding atmosphere; it would be interesting to know, however, the nearest point to the earth at which incandescence has been observed to commence.)

We now require to find some agent capable of dispersing this final barrier of denser air: Now we know that an electric discharge from any given thunder-cloud displaces the air in its passage and forms *pro. tem.* a vacuum; we know, too, that a discharge is not of necessity "forked," but that it may reach the earth in the form of "well-refined ribbons or lines of light;" if, therefore, an aërolite were approaching us under the conditions I have named above, and should enter a thunder-cloud at the moment of an electric discharge, and in a direct line with that discharge, is there any reason why it should not escape dissolution by travelling *in vacuo* in the wake of such a discharge and reach the earth simultaneously with it?

Surely, we may assume that out of the millions of meteoric bodies which enter our atmosphere *some* may *occasionally* pass through the conditions I have indicated, and, reaching the earth simultaneously with the flash, be designated veritable "thunderbolts." CECIL CARUS-WILSON.

Bournemouth, July 20.

HABITS OF THE HESSIAN FLY.

Last year we were told, on evidently good authority, that the exceptionally dry, sunny weather had promoted the multiplication of this vermin to an extent not likely to recur for some time. But this year we learn, on the authority of Mr. F. Enock, F.E.S.—certainly an excellent observer—that "the damp, muggy weather, is decidedly favourable for the development of this pest." If both these views are well founded, the Hessian fly must have a very accommodating constitution. ONE PUZZLED.

A CIRCLE PROBLEM.

Nothing can excuse my carelessness in copying 7896 instead of the next figure 7926 from Whitaker.

I am perfectly familiar with the algebraic demonstration of this problem, but I did not send it to you in the first instance until I found that a number of people who are equally familiar were "caught" in thinking it to be more difficult, or rather more tedious, than it really is. At the same time, "Kuklos's" explanation of the "principle," as he calls it, is—simple though it be—intelligible only to those who have some acquaintance with algebra, while I endeavoured to make it clear to "general readers." A. P. T.

THE COSMICAL ORIGIN OF HAILSTONES.

Replying to "F. M.," p. 70, I must refer him back to my account of the formation of such hailstones. He will there see that the conditions are such that they must be produced simultaneously in countless numbers, forming clouds of ice particles; therefore must visit our earth under special conditions, and in this respect differ entirely from the falling of isolated meteoric stones. (I should add, by the way, that the view there expounded of the modes of formation of the hailstones is my own, suggested by Schwedoff's theory. I have only read an abstract of his paper.) An encounter with such a multitude of ice particles must of necessity produce considerable atmospheric disturbance, especially in summer. If such a cloud of hailstones entered the upper regions of our atmosphere with any approach to planetary velocity, their friction would bring them into the condition of the particles of water forming the cloud produced by Armstrong's hydro-electric machine, which Faraday investigated experimentally, proving that every particle of water therein was intensely charged with positive electricity by its friction against the jet nozzle and the surrounding air. Therefore, if I am right, every terrestrial hailstorm should be accompanied with "special terrestrial weather," *i.e.*, usually with stormy weather, and frequently with lightning, which is notoriously the case, especially in summer. W. MATTIEU WILLIAMS.

THE LANTERN FLY.

In reply to "An Old Entomologist" (SCIENTIFIC NEWS, Vol. 1, p. 525), I beg to say that I have never seen an insect vary its light, nor do I think that the different-coloured light indicates a different species, as I have never detected the slightest difference in the insects. The lights are quite under the control of the insect, as it can shut them off at pleasure, and when in captivity and at perfect rest these lights are quite invisible, but immediately show up as the insect is roused. T.

RECENT INVENTIONS.

The following list has been compiled especially for the SCIENTIFIC NEWS *by Messrs.* W. P. THOMPSON *and* BOULT, *Patent Agents, of* 323, *High Holborn, London, W.C.; Newcastle Chambers, Angel Row, Nottingham; Ducie Buildings, Bank Street, Manchester; and* 6, *Lord Street, Liverpool.*

TESTING FORCE.—A device for testing the force of projectiles has been patented by Mr. A. Harrison. It consists essentially of a disc mounted upon one end of a rearwardly directed and counterpoised bar encircled by a spring, and supported upon anti-friction rollers carried by a fixed framing, and having the force of impact indicated by a pointer worked from the bar.

MAGNETIC APPLIANCES.—A magnetic appliance for medical purposes has been patented by Mr. R. Lonsdale. The invention consists in employing strips of magnetised soft iron and of magnetised steel. These strips are formed into a compound magnet by fixing at each side of a strip of magnetised soft iron a very thin strip of plated hard magnetised steel. When not connected as thus described, the strips of iron and steel are arranged alternately within the case.

ELECTRIC BATTERIES.—Porous pots for electric batteries have been patented by Messrs. E. L. Mayer and H. Liepmann. The object is to so make them that they will always offer a constant resistance to the passage through them of the electrolytes with which they are employed, and it consists in impregnating them with a chemical reagent, and causing this to act upon another chemical reagent, so that a body, which shall not itself enter into any chemical action with the electrolytes detrimental to the action of the battery, may be separated and deposited in the pores of the porous pots.

PIN PLIERS.—Mr. J. C. Young has patented an invention relating to securing the punches in the one jaw and enabling a broken punch to be replaced in pin pliers used for punching holes at varying distance apart. The punches are formed with a head at one end so as to pass through the back of the perforated jaw, and then secured by a plate clamped across the jaw by set screws. The other jaw is formed with a slot into which the article to be punched is placed and held there during the operation. By this arrangement the punches can be more easily replaced when broken.

FRUIT.—A method for preserving fruit has been patented by Mr. W. F. Reid. The invention consists in placing the fruit, which must be perfectly sound, in a layer upon a level surface covered with a layer of mould in a well drained spot. Upon this layer of fruit is placed uniformly sifted mould about two inches in depth for apples or pears. On top of this earth is another layer of fruit, and so on till sufficient has been stored. The sides and top of the heap thus formed is covered with mould about six inches deep, to protect the fruit from atmospheric influences.

RACKETS.—A lawn-tennis racket has been patented by Messrs. F. H. Ayres and A. Foster. The object is to prevent the racket from breaking at the shoulder while in use. Between the frame and wedge piece is placed a piece of elastic material properly coated with glue, and the whole is then put under pressure to set. The holes to receive the strings are made single, and central for a certain distance on each side of the wedge piece; these holes are bushed with metal, so as to increase the strength of the frame by limiting the extent of the material weakened by these perforations, and to lessen the tendency of the stringing to split the wood.

TORPEDO.—Messrs. J. O'Kelly and B. A. Collins have patented a torpedo which is self-steering. To render a torpedo self-steering in any previously determined direction, a fish-shaped one is used, divided into air-tight compartments as usual for containing the explosive charge, the propelling charge, and the engine, and, according to this invention, provided with another air-tight compartment for containing the automatic steering gear. In constructing this gear a compass is employed, together with storage batteries, electrical contacts, electro-magnets, and armature levers operating upon the rudder by suitable gearing and connections to ensure the travel of the torpedo in the direction required.

PARALLEL RULER.—A parallel ruler has been patented by Mr. H. H. Lake on behalf of M. B. L. Aguettant. A ruler and cylinder are united at their ends by connecting pieces through which pass screws attaching them to the cylinder and ruler, and which serve as axes for the cylinder and ruler to turn upon. At one end of the ruler is attached a scale whereby the distance between each line to be ruled is obtained. When not required for use this scale is folded and passes under the rule. When a sheet is to be ruled, the ruler is placed parallel to the head of the sheet, a rotary motion is then imparted to the cylinder with the left hand, the ruler follows the cylinder, and when stopped is always parallel with the head of the paper.

DISTRIBUTING OIL.—Mr. S. Wilding, on behalf of Mr. C. Boye, has patented apparatus for distributing oil over the sea. The invention consists of a bag which is stiffened by bands, and to which are attached rings for convenience of handling the bag. The mouth of the bag is provided with a metal face having perforations through which the oil is intended to flow. Over the inner surface of the perforations slides a correspondingly perforated plate. The travel of the plate is controlled from the outside by means of a suitable handle turning a worm engaging with a rack upon the plate, and the size of the orifices may thus be regulated for the quantity of oil required to flow. The opposite end of the bag has a removable lid through which the bag is filled.

SAFETY LAMP.—A safety lamp has been patented by Mr. G. Smith. Over the wick-holders of a duplex lamp is placed a pair of loosely-fitting tubes provided with the usual shutter, and connected together by a suitable connecting-piece. To a place resting on the body of the lamp-burner between the wick tubes is secured a pair of standards, each carrying a lever, the inner ends of which are connected together, and to a weight by a chain while the outer ends take under the connecting piece. A hole is made in the centre of the body to allow a small threaded conical tube to pass through and be screwed to the plate between the wick tubes. Pendant from this tube is a support carrying the weight, to which is secured a wire bridge-piece, and to this piece is attached the chain operating the lever arms. If the weight be caused to swing the levers raise the extinguisher tubes and puts out the light.

ANNOUNCEMENTS.

Institution of Mechanical Engineers.—The summer meeting will be held in Dublin on the 31st inst. and two following days, and transferred to Belfast on Friday, August 3rd. The Chairman of the Dublin Committee is the Right Hon. the Earl of Rosse, F.R.S., and Vice-Chairmen the Lord Mayor, the Provost of Trinity College, the Rector of the Catholic University, the President of the Institution of Civil Engineers of Ireland, Sir Robert Ball, F.R.S., the Observatory, Dunsink, Sir Howard Grubb, F.R.S., Rev. Dr. Haughton, F.R.S., and a large number of gentlemen connected with the Institution of Engineers and with other professions. On Tuesday, 31st inst., the first meeting will be held in the examination hall of Trinity College, when the President, Edward H. Carbutt, Esq., and the Council will be received at 10 o'clock by Lord Rosse and the members of the Local Committee. The President will deliver an address, and papers will be read and discussed. At 1 o'clock the Reception Committee will entertain visitors to luncheon in the dining hall, and at 2 o'clock will give them a trip in Dublin Bay in a special steamer kindly lent by the London and North-Western Railway Company, to view Alexandra Basin, the departure quays, the dredging apparatus, the Bailey Lighthouse, and Kingstown. At 7 p.m. the annual dinner of the Institution will be given in the great hall at Royal University. On Wednesday the reading and discussion of papers will be resumed at 10 o'clock in the examination hall, and after luncheon, at 1 p.m., the visitors will be taken by special tramcars to the works of the Great Southern and Western Railway at Inchicore, or to the Rathmines Water Works; and in the evening there will be a conversazione at the Royal Irish Academy house in Dawson Street. On Thursday visits will be paid to Powers' distillery and Guinness's brewery, and in the evening a special train leaving Amiens Street Terminus at 7 p.m. will carry the visitors to Belfast. Such as desire to see the Bessbrook and Newry electric tramway will proceed by the ordinary 2 o'clock train. On Friday at 9.30 there will be a reception to the President and Council by the Mayor, Sir J. Haslett, and other members of the Local Committee. At 10 o'clock they will visit Harland and Wolff's shipbuilding yard and marine engine works and other places in the town which contain engineering works of interest. At 1 o'clock the visitors will be entertained at luncheon in the Town Hall by the Mayor and Local Committee, after which they will have a trip round Belfast Lough, by invitation of the Belfast Steamship Company, to see the new dock dredging operations and view Island Lighthouse, and at 8 p.m. a conversazione in Queen's College, Belfast, will terminate the meeting.

SELECTED BOOKS.

The Coleoptera of the British Islands, Part XVI. By the Rev. Canon Fowler, M.A., F.L.S. Vol. I., 14s. Large paper, with 36 coloured plates, 48s. Vol. II. 18s. London: L. Reeve and Co. Price 5s.

METEOROLOGICAL RETURNS

For the ten weeks ending on Monday, July 16th, 1888. Specially prepared for Scientific News from official reports.

	Mean Temperature.	Rainfall.	Duration of Sunshine.
Scotland, East	50·1 degs., being 3·0 degs. below average.	6·8 ins., being 1·4 ins. above average.	433 hrs., being 9 hrs. below average.
England, N.E.	50·8 " " 3·9 " " "	5 6 " " 0·7 " " "	345 " " 96 " " "
England, East	54·1 " " 2·8 " " "	5·4 " " 0·5 " " "	381 " " 137 " " "
Midlands ...	53·6 " " 2·9 " " "	6 2 " " 0·8 " " "	358 " " 91 " " "
England, South	54 0 " " 2·2 " " "	6·0 " " 1·6 " " "	382 " " 86 " " "
Scotland, West	52·3 " " 1·1 " " "	8·7 " " 2·4 " " "	440 " " 36 " above "
England, N.W.	53·1 " " 2·7 " " "	6·0 " " 0·6 " below "	381 " " 72 " below "
England, S.W.	54·4 " " 2·1 " " "	7·2 " " 0·9 " above "	442 " " 57 " " "
Ireland, North	52·7 " " 2·2 " " "	8·1 " " 2·0 " " "	403 " " 23 " above "
Ireland, South	54·9 " " 1·1 " " "	8·4 " " 2·0 " " "	417 " " 7 " below "
The Kingdom...	53·0 " " 2·4 " " "	6·8 " " 1·2 " " "	398 " " 50 " below "

The sunshine value for the kingdom, after having steadily risen week after week, until 422 hours for ten weeks was attained has for the above period fallen to 398 hours; the maximum period of sunshine for 1888 is therefore past. The excess of, rainfall has now attained an inch and a quarter for the kingdom, its distribution being much more equal; temperature for the kingdom has fallen from 2 deg. below the normal in last week's report, to 2·4 deg. below.

Scientific News

FOR GENERAL READERS.

FRIDAY, AUGUST 3rd, 1888.

CONTENTS.

SCIENTIFIC TABLE TALK.

By W. Mattieu Williams, F.R.A.S., F.C.S.

Another series of Mr. Spitta's experiments were made by dissecting, so to speak, the representative planet, cutting a hemispherical shell into first a central segment of 30 degs., then a series of annular segments or zones from 30 degs. to 60 degs., from 60 degs. to about 70 degs., and from 70 degs. to 90 degs., and making transits over these. The results of these experiments, briefly stated, were that when the little moon with albedo of 0·13 advanced towards the artificial planet with the central segment *in situ*, or removed, no apparent change was due to this removal; the same occurred when the moon was placed on the limb; and the same again when the moon was placed on the zone at about the angle of 65 degs. to 70 degs.; in like manner the removal of second zone made no difference; but when the moon was placed on a portion corresponding to about the angle of 60 degs. it appeared *exceedingly black* while the central portion remained, but recovered most of its brilliancy when the central portion was removed, it then merely appeared "rather more tinted than usual;" when the second as well as first zone removed, the moon recovered its original brilliancy.

I must not be tempted into proceeding with further details, but must refer any readers who desire to study the subject further to the Monthly Notices of the Royal Astronomical Society of November, 1887, where they will find the original paper. I have no doubt that all who read it carefully will agree with me in regarding it as a very able and important contribution to physical astronomy and optical science, worthy of far more attention than it appears to have hitherto received.

It will be noted, of course, that in both cases of planet and satellite we are dealing with spheres that reflect the radiations from the sun. If the surface of the orb were perfectly polished all the sides curving away from us would be invisible; only the central portion would be seen, and this, if sufficiently magnified, would present to us a mirrored image of the sun.

Thus, a moon as big and as near to us as our existing satellite would display merely such an image diminished to a brilliant speck of light. That we are able to see the hemispherical rotundity is due to the kind of reflection, the "scattering" reflection, which is common to all ordinary surfaces, and by virtue of which ordinary objects become visible in their actual form. If all the objects in a given apartment had perfectly polished surfaces, and a gas flame were the source of light, nothing more than a multitude of gaslights would be visible.

But the sun is spherical, and is visible by virtue of his own luminosity. How is this apparent luminosity affected by the obliquity of various zones in reference to our line of vision?

This question has been the subject of many experimental investigations. Omitting those relating to the spectrally dissected rays, I may quote Pickering's results for the general light. Calling the sun's centre 100, and dividing the radius of the visible disc from centre to limb into 100 parts, he found that at 10 parts distant from the centre the luminosity was reduced to 98·8, at 40 to 94, at 50 to 91·3, at 60 to 87·0, at 75 to 78·8, at 85 to 69·2, at 95 to 55·4, and at 100, *i.e.*, at the very edge of the limb, to 37·4.

From this it appears that the loss of light due to obliquity is far less than in the case of Spitta's ball of plaster of Paris.

Our mathematicians affirm, on theoretical grounds, that "an incandescent sphere of metal or an illuminated globe of white glass (like the shade of a student-lamp) appears sensibly of equal brightness all over, the foreshortening of each square inch of surface inclined to the line of sight just compensating for its diminished radiation" ("The Sun," by Dr. Young, chap. viii.); and they attribute the diminishing luminosity of the different zones of the sun, proceeding towards the limb, to the absorption of his light by his own atmospheric envelope, this absorption increasing, as it evidently must increase, with the obliquity, simply because we are looking through a greater depth of such atmosphere when our line of sight is oblique than when it is perpendicular. This difference corresponds to that of our daily experience in our own atmosphere. The sun appears far less bright on our horizon than overhead, because when on the horizon we are looking at him not merely through the depth of our atmosphere, but also through a great thickness in horizontal direction.

The sun certainly has a great atmosphere of his own, and if Spitta's results apply to self-luminous bodies as well as to those illuminated by scattering reflection the diminution of solar luminosity as we proceed from centre to limb should be greater, not less, than in the case of the plaster of Paris ball.

Some experiments that I made about twenty years ago supply a solution of this enigma. They were made with the photometric apparatus of my old friend Mr. Jonathan Wilkinson, the Official Gas Examiner to the Sheffield Corporation, and with his valuable assistance. My object was to learn whether a flame is transparent to its own radiations, or, stated otherwise, whether a flame of given intensity and exposing to the photometer a given area gives out an increased quantity of light proportionate to increased thickness or depth in the line of sight. Our experiments were numerous, as the earlier experiments proved the necessity of precautions that were not self-evident *à priori*. Thus we found that two jets from the same-sized holes, and each burning the same quantity of gas when placed in contact one behind the other, gave more than double the light of either, 2·15 times, and three jets gave 3·2, five jets gave 5·35, although the supply of gas was regulated respectively to double, treble, and five times the quantity supplied to the jets when burning singly.

Without entering into further details (for which see "The Fuel of the Sun," chapters vii. and viii.), I may describe the most conclusive experiment which was made with five simple round jets arranged in line about one inch apart, and each with a separate tap. These were adjusted to equal heights, and the row presented broadside to the photometer, so that all the jets were separately radiating towards it. They were then turned so that, instead of five jets being presented to the photometer screen, only the end one was presented to it, and thus the radiations from all the other four must pass through this one. The photometer indicated no difference, though in the first case five times the area of flame was presented. The observer was so placed that he only saw the disc of the photometer, the luminous object being completely hidden from him. We turned the row of jets round and round several times, changing places as observer and manipulator, and could not tell which presentation, whether broadside or endwise, was made; our guesses, based upon supposed increase of light, were as often wrong as right.

Similar experiments have since been made by others who used fishtail and batswing burners, turning these as we turned our row of equal jets. They found, as we did in our preliminary experiments, that the edge presentation of these gave less light than the broadside, but failed to learn the reason. It is that such flames have irregular summits, and that the edge view includes something more than thickness of flame—viz., a thickness of gas and vapour between the tips of the luminous tail-summits through which the hinder tail summits must radiate. It is well established that such vapours are especially opaque to the radiations from the flame of which they are the product.

Applying this fact of free radiation of flame through flame to the case of the sun, and assuming that the photosphere of the sun consists of flaming matter of considerable depth, we have in such depth a compensating factor to the varying depth of solar atmosphere presented to us. The visual depth of atmosphere and the visual depth of flame will vary equally with the different distances from the centre of the visual disc.

I may add that the above-described experiments were made in order to ascertain whether the great energy of the solar radiations could be explained without recourse to violent hypotheses concerning the temperature and intrinsic luminosity of the solar material—without calling upon the scientific imagination to create forms and affections of matter different from those existing here on our earth.

THE FOURTH EXPEDITION OF THE "HIRONDELLE": NEW DEVICES FOR DEEP-SEA DREDGING.

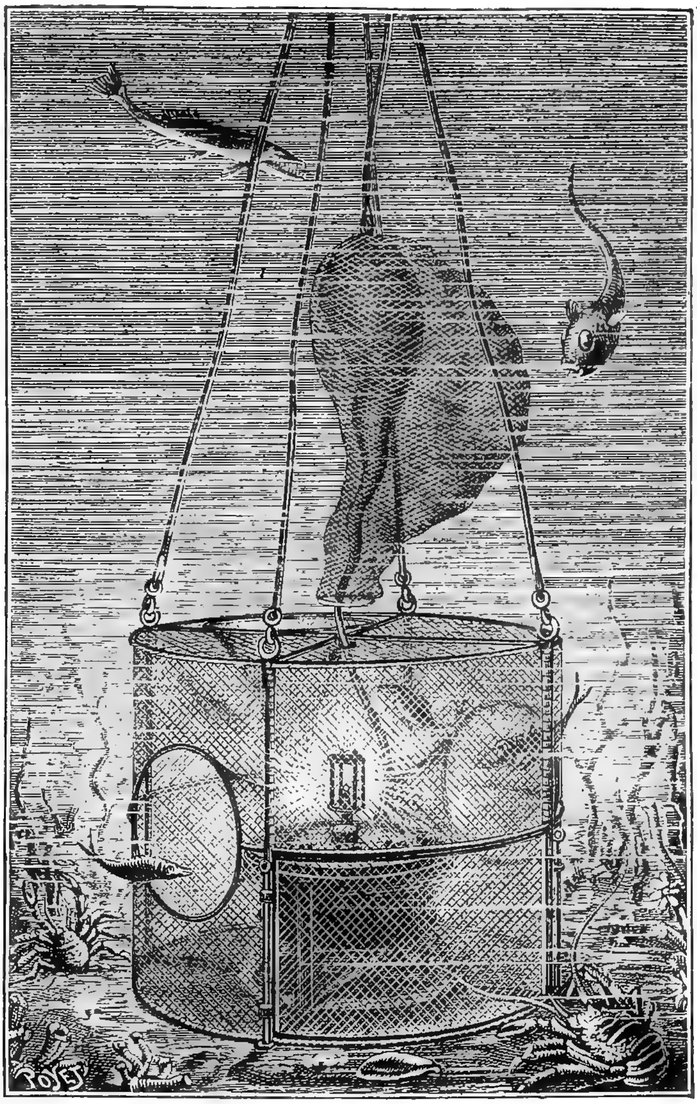
SOME mention has already been made of the *Hirondelle*, which under the command of the hereditary Prince of Monaco, continues with success the explorations of the *Talisman* and the *Travailleur*. This vessel, admirably equipped for a scientific cruise, has just sailed from L'Orient for the Azores, in order to dredge at great depths. The appliances for the expedition are numerous. We must first mention the cable for lowering the other apparatus to the bottom. It is more than 4,500 yards in length, and is formed of six strands of steel wire, forming a rope not so thick as a penholder, but capable of bearing a strain of more than 2,200 lbs. It realises, therefore, all the conditions required. It is coiled upon a drum, and consequently does not prove an encumbrance; it is not heavy, and still it is capable of resisting the severe strain required in drawing back the dredges from great depths. The vessel carries also sounding-leads of a new model for bringing to the surface the mud from the sea bottom for the study of the numberless organisms which swarm therein. Self-registering apparatus will record at every moment the condition of the sea, the height of the waves, and the movements of the vessel. Lastly, the improved dredges will enable the explorers to search the abyss with more care than has ever been done before.

Amongst the instruments of an entirely novel type embarked on board the *Hirondelle*, and doubtless destined to yield unforeseen results, are what may be called abyssmal traps.

The article on the "Sea Dredge," SCIENTIFIC NEWS, vol. ii., p. 60, has made everyone acquainted with the general manner in which deep-sea dredging is effected. A kind of large bag, held open by an iron frame, is attached to the ship by a strong cable; this drags the dredge after it, and thus scrapes the bottom of the sea. It will be seen that if this method be in a manner convenient, it is imperfect. The dredge accumulates as much mud as animals; however strong it may be it is liable to be torn upon the points of rocks; if it collects delicate organisms, which often happens, it makes a complete paste of them. Further, it catches only those animals which crawl at the bottom. Every agile creature easily gets out of the way. Hence we know little as yet of the wonders of the abyss. Two of the explorers of the *Hirondelle* have sought to entice the animals of the deep by means of baited snares, and from this idea there have sprung the baskets of the *Hirondelle* and the electric appliance of Dr. P. Regnard.

The traps are very like those used on our coasts for catching lobsters, only in place of being a few inches in length they are two yards. Our figure, taken from *La*

Nature, shows one of these contrivances which can be dismounted, so as to take up less room on board. When wanted for use it is merely required to connect the two halves by hooks in order to have a closed basket, into which is put a little bad fish, and which is then let down by means of the steel cable. At the top is placed a floating buoy, and the apparatus is then left in the sea. On returning in a day or two and raising it briskly an ample harvest is secured. This is not merely hope or conjecture, as the former voyages of the *Hirondelle* have already given surprising results.



In 1886 and 1887 traps of this sort were let down: one day one of them was raised containing more than 60 lbs of fishes and crustaceans. Unfortunately the hemp cables then in use were not strong enough and gave way, abandoning all this treasure to the sea. No such accident can happen with the steel cable.

Dr. Regnard has had the happy idea of lighting up one of these apparatus. It is known from recent investigations that beyond 400 yards there does not penetrate into the water light enough to act upon the most sensitive plates. Such a plate, which is over-exposed in $\frac{1}{100}$ of a second, may remain uncovered for 10 hours at great depths, and yet be perfectly unacted upon. The animals of the abyss are therefore deprived of light; they live in complete darkness, and their eyes serve merely to see the phosphorescence of their own bodies, or the feeble light which other beings diffuse. But from this to the electric light is a long step. Yet Dr. Regnard wishes to introduce it into the depths. He wishes to use it as a bait to capture the special forms which it may attract, or at least to learn if the inhabitants of the abyss flee from the light, like those of caverns, or if they seek the light.

This is not the earliest attempt to use light in fishing. It generally attracts animals. Moths come to burn themselves in candles; sea-birds dash against the lenses of lighthouses with such force that they are often killed, and their dead bodies are found at the foot of the tower. Fishes flock so readily to a light that fishing by torchlight is forbidden by law in some countries. Indeed, whatever shines attracts the inmates of the waters; a fragment of a broken plate is a good bait for lobster pots.

The notion of lighting up the sea for fishing has presented itself to many minds. Three years ago the *Talisman* drew behind her a lamp immersed some metres in the sea. A short time ago an English scientific society set out from Liverpool on board the *Hyaena*, and tried illuminating the sea to the depth of some fathoms.

But to convey the electric light to depths exceeding 1,000 yards is a much more difficult problem. The first suggestion was to let down an apparatus communicating by a cable with the ship in which the electric current was generated. This proved absolutely impracticable. The sole expedient is a battery let down to the bottom and left in the trap. But then there appeared a new difficulty. The apparatus will have to support a pressure of as many atmospheres as there are above it multiples of 32 feet of water. At 4,000 yards it would have to bear, approximately speaking, 400 atmospheres, a pressure which few materials and few connections can support. Dr. Regnard's invention consists in doing away with the pressure at whatever depth, or, at least equalising the inside and the outside pressure. This he effects as follows:—

The trap which he uses is cylindrical, with three apertures and a door. On the bottom rests a "Cardan" suspension containing a sort of iron pot closed with a lid. This lid closes with iron pins, which press upon a ring of caoutchouc. Into this recipient are put seven Bunsen elements, in which chromic acid is substituted for nitric acid. Each of the cells of these Bunsens is closed with a plate of caoutchouc to prevent the liquids from getting mixed by any sudden movement. All these elements, combined in tension, feed an Edison lamp of 12 volts enclosed in solid glass. The inside and outside pressure are equalised by the following arrangement. Above the trap is a balloon of caoutchouc enclosed in a net which supports it during the immersion. A tube leads from this balloon into the interior of the pot containing the battery.

On lowering the apparatus into the sea the balloon is compressed, and it injects into the iron pot so much air that the inside pressure is just equal to the outside pressure. All that is required is to calculate the capacity of the pot so that it may be proportionate to the capacity of the balloon and the depth to be reached. The same principle is applicable to all kinds of apparatus.

MECHANICAL REFRIGERATION.

CONSISTENT with many other theories, and in accordance with the old methods of scientific thought, the idea of "an imponderable fluid" called caloric was used until the end of the last century to explain the phenomena of heat. Lord Bacon, as he is generally called—though his name was either Francis Bacon, or Lord Verulam, for we do not speak of Lord Disraeli—had long before expressed his opinion that heat consists of a "kind of motion or brisk agitation of the particles of matter." In that remarkable work, the *Novum Organum*, which the classical scholar generally thinks is a dry list of scientific facts, but which is full of quaint ideas and amusing theories, after recounting a number of sources of heat, among which he alludes to the friction of trees rubbing against one another in a high wind, he says: "From these examples, taken collectively as well as singly, the nature whose limit is heat appears to be motion;" "the very essence of heat, or the substantial self of heat, is motion and nothing else." Unfortunately there was but little method in the scientific thought of these days, the theory-making was little else than guess-work. Neither enough evidence was collected, nor was sufficient care given, first to sift it, and then to reason upon it in a really scientific manner.

Count Rumford and Davy completely disproved the material or caloric theory of heat, and showed by experiment that an unlimited amount of heat could be obtained by purely mechanical means.

According to the old theory, the caloric fluid permeated the substance of bodies, and could be squeezed out, like water from a sponge. The heating of a piece of iron by the blows of a hammer was thus explained. The idea of the presence of caloric in a body was sometimes mixed up with the notion of "latent heat," and some persons have been led to think that because the caloric theory has been completely exploded, that the theory of latent heat is also unorthodox.

"Science is measurement," and before proceeding to discuss the subject of heat, it is necessary to have some definite ideas about its measurement, and the units by which it is measured. The English unit of heat is that which will raise one pound of water one degree Fahrenheit; strictly speaking, from freezing point to one degree above, for at high temperatures a little more heat is required. If we take a lump of ice weighing one pound, and apply sufficient heat to raise one pound of water one degree, the temperature of the ice will not alter, but some of it will become melted. On applying another unit of heat, a little more will melt. We should have to supply as much heat as would raise 142 lbs. of water one degree Fahrenheit, or one pound of water about 142 degrees, before all the ice was melted; and, until all the ice had disappeared, the temperature of the mixture would remain unaltered. Where has all the heat gone? It has become latent in altering the water from the solid to the liquid state. It exists no longer as heat, but as the energy of motion of the molecules of the water. To freeze the water again, 142 units of heat must be abstracted.

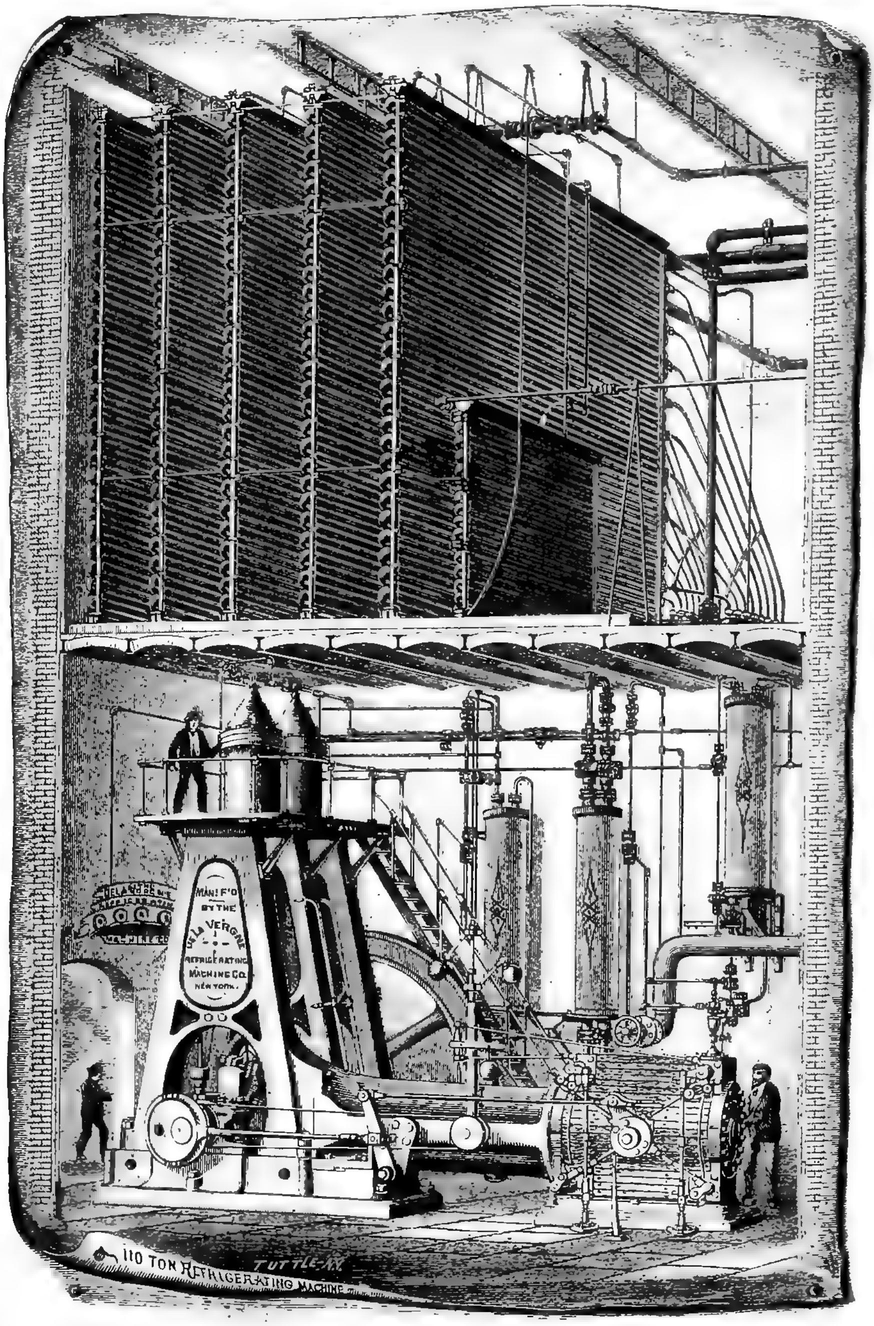
It is easy enough to produce heat by mechanical means, in fact it is impossible to avoid doing so to some extent whenever work is done, for in every machine there is some friction, and where there is friction there is heat. To produce cold is not so simple.

Most substances expand when they are heated, and contract when they are cooled. And conversely, when they are compressed their temperature rises, and it falls when they are allowed to expand.* If a piston carrying a bit of tinder be suddenly thrust down a well fitting brass tube, closed at the bottom, the air will be heated enough to set fire to the tinder; such an appliance was once common in Germany.

If the piston be allowed to spring back at once, the heat which was generated by the compression is absorbed by the air, as it returns to its original bulk. But if, while compressed, it be cooled by a spray of cold water; when it expands it will be reduced in temperature. On this principle most of the refrigerating machinery on board the ships which carry frozen meat is constructed. The

* Indiarubber is an exception. If an elastic band be suddenly extended while it is touching the lips it will feel warm, and when it is relaxed it will feel colder.

air is easily reduced to many degrees below freezing point, and is blown into the chambers in which the meat is placed. One advantage of this system is that the whole of the air in the chamber is reduced to the cold temperature, and while it surrounds and passes over the meat in a continuous current, it ensures a thorough chilling, and complete ventilation as well. One great difficulty, however, is that any moisture in the air is thrown down as a shower of snow. This is liable to obstruct the air-passages, and boys have to be sent through them to clear it away. Even if the atmosphere be comparatively dry, the spray of water used to cool the air after it has been compressed, will load it with moisture. Compressed air, however, will not hold so much vapour as at ordinary pressure, and, when it is compressed, the water becomes a cloud of mist or fog. When it expands this fog is absorbed again. When the spray of cold water is injected, it makes most of the fog settle, in fact it washes it out of the air, and leaves only as much vapour as it can hold at that pressure, so that we have the curious paradox that it is possible to dry air by wetting it.



If we take instead of air, some gas or vapour which when compressed, can be liquefied, we can make use of the latent heat of liquefaction, which disappears when the liquid reassumes its gaseous form, precisely as heat disappears when ice loses its solid form and becomes water.

Bulk for bulk, we can get the same effect from 42 cubic feet of ether as from 100 cubic feet of air. But ether is inflammable and expensive, and we can get the same effect with only 23 cubic feet of anhydrous ammonia. Ordinary *aqua ammoniæ* or "spirits of hartshorn" is a solution of ammonia gas in water. The greediness with which water will dissolve ammonia is used in another form of refrigeration which is not strictly mechanical, and which we must leave for another occasion. The ammonia compression system is the same in principle as the compressed air method, but the ammonia gas itself is not liberated in the chill rooms, but circulates in iron pipes.

One of the most perfect systems of ammonia refrigeration is that of the De La Vergne Co. of New York, and in the hands of Messrs. L. Sterne and Co., of Westminster and Glasgow, it is being most successfully introduced into this country. Few passengers in Gracechurch-street during this uncertain and muggy weather, know that within a few feet of the pavement there is an unvarying temperature of about 22° Fahrenheit, in which thousands of carcases of mutton are stored in chambers, tons of Russian hares and game, waiting until they are "in season," or to be consumed by the owners out of season. The meat seems as hard as stone, and a pair of fowls knocked together ring like flints. The air is so dry that it is difficult to believe that the temperature is ten degrees below freezing point.

Electric light glistens on the hoar frost which lies thick upon the pipes that run along the ceilings; they are provided with cast-iron discs, which afford a large surface for the absorption of heat. In these pipes the ammonia gas is passing. On leaving the chill-rooms the ammonia, in the form of a gas at about 15 to 18 lbs. pressure, enters at the bottom of a compressing pump which is worked by a Corliss engine. With the gas, mineral oil is forced in. This seals the valve and stuffing-box of the piston rod, and some of it is carried up with the piston, sealing the valves with which it is provided, and lubricating the cylinder at the same time. At the end of the up stroke, not only is all the gas expelled, but some of the oil as well. The ammonia is now at a pressure of 150 lbs. The pure gas has so much better a result than a mixture of ammonia and water, that the cooling is not effected by a shower of water as in the air compressing system, but it is led through long coils of pipes, shown in the illustration on the floor above the engine. A stream of water flows over these pipes, and the warm gas entering at the bottom, gradually exchanges its heat with the water, which runs off below at about the temperature of the warm ammonia, while the gas which reaches the top is at the temperature of the cold water. In the language of the caloric theory it would be said that the warm water leaving the cooler, carries off the caloric which has been squeezed out of the ammonia by the pump. Very little of the gas reaches the top, for the cooling combined with the pressure liquefies it, and as fast as it becomes condensed, it runs off by the pipes shown at the right-hand side of the cooler. It now is stored in a tank as cold liquid ammonia, the oil having been separated by a system of tanks which we have no space to describe. From the tank, the liquid is led to a row of valves provided with very small wedge-shaped openings, by which very accurate adjustment can be made. These valves open into the circulating pipes which run through the chill-rooms. In the cooling coils, the ammonia parted not only with the heat generated by the compression in the pump, but with the latent heat which would be necessary to boil it from the liquid into the gaseous state. As it rushes through the valve into the circulating pipes, and resumes the form of gas, the latent heat is abstracted from the pipes, and these becoming intensely cold, chill the surrounding air. In addition to the chill-rooms, the same machinery is used for making ice. For this purpose the ammonia in expanding, circulates in a set of pipes like those of the cooler shown in the illustration above the engine. A stream of strong brine flows over them, and becomes chilled to a temperature of about 23°. It is then pumped into a large tank, in which are placed a number of cans containing distilled water. This water being not only pure, but also free from air, freezes into blocks of ice as clear as crystal; and solid all through. These are so much below freezing point when removed from the cans, that if two are left touching they will instantly freeze hard together.

BIRDS' NEST, OR ELEPHANT ISLANDS.

Part I. of Vol. XXI. of the *Records of the Geological Survey of India* furnishes some interesting information concerning this remarkable group called by the Burmans Ye-eigent-thaik (lit., sea-birds' nests) at the southern extremity of Burma. It is a small group of six marble rocks, the highest and largest of which, 1,000 feet in height and above one mile in length, is oval shaped, and rises very abruptly out of a depth of only five fathoms. The sides are partly clothed with vegetation wherever a break in the limestone has left a cleft in which moisture and dust can lodge. Conspicuous is a species of tree-fern which grows at any angle, but only above a height of 200 feet from the water. The face of the rocks is reddish, and where cliffs exist most beautiful stalactites are in course of formation. But the great feature of the group are the birds' nest caverns, which, as a rule, open into the sea, the entrance being below high-water mark. At half-tide a tunnel opens under a wall of rock at the head of a deep cove in the big island; this tunnel has a roof-covering with large stalactitic knobs. Passing through this, one emerges into another circular basin with perpendicular sides, which gives the impression of volcanic action. Great caverns opening into circular basins exist in other parts of the island, and Commander Alfred Carpenter, R.N., who writes the account, states that the impression gradually forces itself on one that these circular basins were at one time the floors of huge caverns, and that, in days gone by, the islands were far higher with cavern piled on cavern, and that the work of disintegration by moisture is slowly going on pulling down these marble monuments of the past.

Progress of the Asbestos Trade.—The output of asbestos at the Canadian mines has risen from 300 tons in 1879, to 3,458 tons in 1887. It is now considered to yield the best and safest returns of any kind of mineral. A somewhat curious fact is that in China asbestos ranks among the medicines for inward use, being regarded as a tonic.

General Notes.

Professor J. C. Houzeau.—We much regret having to put on record the death of Professor J. C. Houzeau, the eminent Belgian meteorologist.

Strange Impurity in Milk.—Hermann Thoms alleges, in the *Pharmaceutische Zeitung*, that he has detected ultramarine in a sample of milk as offered for sale.

An Artesian Well in Queensland.—An artesian well has just been completed at Blackall, in Queensland. A bed of good water was struck at the depth of 1,600 feet, and a flow of 280,000 gallons daily is secured.

Height of Waves.—According to *Ciel et Terre* the waves of the sea may exceptionally reach the height of 56 feet. D'Urville records waves of 90 feet in height, which is more than double the figure given by other observers.

The Cultivation of the Senses. — The *Popular Science Monthly*, discussing industrial training, says:—"We expect a well-developed perceptive power in the senses, delicacy of touch, a minutely trained ear—yes, even nose." Surely the nose is of far greater importance in science than the ear!

British Museum Library.—It is understood that the name of Mr. Edward Maunde Thompson, Keeper of the Department of Manuscripts in the British Museum, has been submitted to Her Majesty by the Principal Trustees of the Museum for appointment to the post of Principal Librarian, in succession to Mr. Bond.

Japanese Honours.—The Emperor of Japan has been pleased to confer the fourth class decoration of the Order of the Rising Sun on Professor J. M. Dixon, M.A., F.R.S.E., of the Imperial University in Tokio, Japan. Professor Milne, the well-known seismologist, who is on the staff of the same institution, was also decorated.

British Association's Visit to Newcastle.—A Local Committee has been formed in connection with this visit, and it has been decided to prepare a Local Guide giving a brief sketch of the industries, natural history, and general history of the Northern counties. The three editors are, Historical Section, Dr. T. Hodgkin; Natural History, Prof. Lebour; Industries, Dr. Wigham Richardson.

Danger of Refrigerated Water.—According to the *Medical Press*, twelve workmen died lately at the manure works of Prairie-au-Duc. The disease was pneumonia, and it was ascribed to inhaling phosphates (volatile fluorides?) or the dust of dried fecal matter. On inquiry, however, it appeared that the premises were irreproachable from a sanitary point of view; but it appeared that the men, when heated, were in the habit of drinking freely from a vat in which refrigerated water was kept for certain uses in the factory. This is a warning for the lovers of iced water.

Loofah.—The *Börsenzeitung* directs attention to the growing use of loofah as a substitute for sponge. This curious substance is the skeleton-like, fibrous covering of a species of cucumber which grows in tropical climates. The proprietors of the extensive loofah works at Halle were the first to recognise its value as an adjunct of the bath, and to make of it an article of commerce, and they have created a considerable industry in collecting, preparing, and converting it for use. Enormous quantities are exported to all the principal markets of the world. A large quantity is now manufactured into inside soles for shoes. The latest development of the trade is to apply it to the under side of saddles, its principal merit in the application being that it tends to keep the horse's back cool.

Consumption and Coal Miners.—Dr. Nasmyth's results, given in our Abstracts, must be regarded as not a little remarkable, for it seems to have been clearly demonstrated by geologists and others that phthisis is always more prevalent where the soil and air are unusually damp, and that conversely the drying up of the moisture by drainage has always resulted in a marked decrease in the mortality from this cause. And yet, according to Dr. Nasmyth, we have here a very low proportion of lung disease among men who habitually work in air which is "nearly always saturated." If statistics from wider coal-mining areas bear out these observations it would certainly appear that some other cause than mere dampness has a share in inducing consumption; and as the ground beneath and around the mine must be saturated with water, while the temperature is shown to be closely similar to that obtaining above-ground, it is not, in the present state of our knowledge, very easy to see what other influential factor could enter into the question.

Structure of a Flash of Lightning.—M. E. L. Trouvelot, during the storm of June 24th, at Paris, succeeded in obtaining the photograph of a flash of lightning, and submitted the proof to the Academy of Sciences on the 9th inst. This flash, which seemed to connect the earth to a cloud, subtended an angle of 40°. The flash appears divided in four main branches, brilliant and strongly-marked. But there were others less visible, some so faint that they could not be seen in the negative without the help of a lens. The total number of the branches, large and small, is thirty-seven. A microscopic examination of the image of the flash shows that it is like a long ribbon, taking all the forms which a ribbon might present if plunged into a slowly-moving liquid. This ribbon seemed to be traversed vertically by a multitude of rays more or less close together, and more or less brilliant. They are seen almost everywhere upon the flash, even upon its faintest ramifications. They correspond in general with the fracture of the zigzags which seem to make up the flash.

The Distillation of Sea Water.—The Government is fitting a distilling apparatus in many of the new ships, which has several features to recommend it. It has been necessary heretofore to have a donkey boiler, or to set one main boiler aside for use in distilling, and either plan has its inconveniences. As steam will be used constantly in the new ships for power purposes, with the new arrangement, the same boiler can also be used for making fresh water without the oily unpleasantness that usually accompanies distilled water made from a boiler fed from a surface condenser. Steam from a special boiler is led through a series of coils, which are contained in a vessel supplied with sea water. The steam is condensed, or partly so, and falls in the condenser. A portion of the sea water is evaporated and is carried into a second coil, in which it is also condensed, and this water is of excellent quality. The first vessel is fitted with blow-off and brine cocks, and occupies very much less floor space than a donkey boiler of the necessary capacity would do. A test made with one of these arrangements, having 52 square feet heating surface in the evaporator, maintained a pressure of 51 lbs., and had a capacity of 900 gallons of water per day.—*Industries.*

Burmese Diet.—A correspondent of the *Rangoon Times* gives a curious account of the Burmese *cuisine.* They utterly reject milk—which in hot climates is admittedly questionable—as also butter and cheese. On the other hand, they have a fondness for putrid fish. The blood of a monkey is thought to be a very strengthening draught. Frogs, lizards, snakes and their eggs figure largely in the Burmese bill of fare. A monkey, roasted whole, is considered a certain cure for dysentery. The greatest peculiarity of these people is insect-eating. A large red ant (*Myrmica*) is caught in great numbers and pounded up as an ingredient of chutney, to which they give a peculiar acidity. The writer had set before him at tiffin a small basin nearly full of honey, in which were large white grains, like oversoaked grains of rice. He found the mixture delicious, "tasting like very delicate bits of marrow, cooked in honey. It consisted of bee-grubs stewed in honey." Some of their insect delicacies are much more questionable, such as the larvæ of a beetle (*Scarabaeus*) that rolls up balls of cow-dung. A mole-cricket (*Schizodactylus monstrosus*), called in the native tongue *jhingur* is consumed, as are also the larvæ of a palm-weevil (*Calandra*).

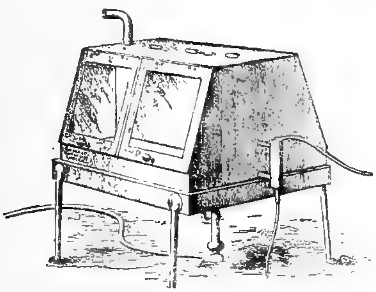
Electrical and Allied Trades.—A preliminary meeting was held on July 27th at the offices of the London Chamber of Commerce, Botolph House, Eastcheap, to consider the desirability of forming a section, or Committee, in connection with the Chamber to represent the electrical and allied trades. Mr. R. E. Compton presided. In a circular convening the meeting, issued by Mr. K. B. Murray, the Secretary to the Chamber, it was stated that the proposed section, if formed, would not interfere with the work of existing associations, but would only deal with matters that were purely commercial. The section, it was added, would be an integral part of the London Chamber of Commerce. Among the matters with which it was suggested that the section might deal were mentioned Bills before Parliament, foreign tariffs, treaties of commerce, customs classification, arbitrations, business extensions in India and the colonies, electric lighting legislation, fire insurance rules, and telephone and telegraphic matters. The Chairman of the section, or Committee, would possess a seat on the Council of the Chamber. In opening the proceedings the Chairman stated that two meetings had already been held recently on the subject. Previous efforts had been made to form a Committee for the electrical trades, but they had not been successful, as they had not represented the entire trade. After some discussion a resolution was passed appointing an organising committee for forming the section, the Committee to report to a future meeting of the Electrical Trades Committee.

Death of Professor Carvell Lewis.—Scientific men in general, and especially geologists, will hear with regret of the death of Dr. H. Carvell Lewis, Professor of Geology, Philadelphia, U.S.A., which occurred on Saturday last at Manchester. Professor Lewis arrived at Liverpool on the 11th inst. by the steamer *Alaska* from New York, being accompanied by his wife and a party of friends, among whom were Dr. G. H. Williams, Professor of Geology at the John Hopkins University, Baltimore, and Professor H. Langden Mitchell, son of Dr. Weir Mitchell, of Philadelphia. The main object of their visit was to attend the annual meetings of the British Association and the British Archæological Society, and in the intervening time it was intended to make visits of geological investigation to the mountains of Westmoreland and Cumberland and to Norway, and Professors Lewis and Williams were pursuing studies in microscopical geology at Manchester in connection with the latter of these projected expeditions. It seems that Professor Lewis had contracted an illness, now believed to have been due to drinking impure water before leaving New York, and that what was subsequently thought to be ordinary sea-sickness was probably a continuation of the same malady. He appeared to improve towards the end of the voyage, but some time after reaching Manchester symptoms of typhoid fever supervened, which terminated fatally on Saturday. Dr. Lewis was only thirty-five years of age, and leaves a widow and one child. English geological readers will remember his contributions to glacial geology which gave rise to considerable discussion at the British Association meeting last year, and will join their American brethren in regretting his untimely decease.

The Public Health.—The Registrar-General's return for the week ending July 21st shows that the deaths registered during that period in 28 great towns of England and Wales corresponded to an annual rate of 16·0 per 1,000 of their aggregate population, which is estimated at 9,398,273 persons in the middle of this year. The six healthiest places were Brighton, Nottingham, Hull, Derby, Blackburn, and Cardiff. In London 2,385 births and 1,297 deaths were registered. Allowance made for increase of population, the births were 374, and the deaths 539, below the average numbers in the corresponding weeks of the last ten years. The annual death-rate per 1,000 from all causes, which had slowly increased in the five preceding weeks from 14·2 to 15·7 further rose last week to 15·8. During the first three weeks of the current quarter the death-rate averaged 15·4 per 1,000, and was 5·7 below the mean rate in the corresponding periods of the ten years 1878-87. The 1,297 deaths included one from small-pox, 25 from measles, 14 from scarlet fever, 15 from diphtheria, 33 from whooping-cough, eight from enteric fever, 62 from diarrhæa and dysentery, two from choleraic diarrhœa, and not one either from typhus or ill-defined forms of continued fever; thus, 160 deaths were referred to these diseases, being 388 below the corrected average weekly number. In Greater London 3,127 births and 1,589 deaths were registered, corresponding to annual rates of 29·5 and 15·0 per 1,000 of the estimated population. In the Outer Ring 11 deaths were referred to whooping-cough, 10 to diarrhœa, and 7 to diphtheria. The fatal case of diphtheria included three in Croydon and two in Walthamstow subdistricts. In our abstract of the Registrar-General's previous report Bristol should have been placed first among the six healthiest places for the week ending July 14.

IMPROVED LABORATORY OVEN AND BATH.

THE accompanying illustration represents Professor Reynolds' improved water oven and bath for laboratory use. It is a well-contrived and most useful apparatus, and we have much pleasure in recommending it to chemists and physiologists. The illustration shows an enclosed chamber on one side, with a glass door, and there is a similar chamber on the opposite side, with a space between the backs of the two chambers. There is also an enclosed space about 3 ins. deep under the two chambers, which is filled with water. The water is supplied through the upper tube at the end, and it is kept at a constant level by an overflow pipe inserted in the short vertical tube shown in the figure. If there be any waste water it is carried away by the bottom tube at the end. At the opposite end (not shown in the figure) there is a water gauge, by means of which the water level can be seen at any time. The water is heated by a Bunsen lamp underneath, and the whole of the apparatus is made of copper which conducts heat readily without much loss from radiation. Any temperature up to 100 degs. C. (212 degs. F.) can be steadily maintained, and this cannot be said of the water baths generally in use. Each of the enclosed chambers is fitted with shelves to receive test tubes, etc., and in each there is provision for a thermometer. On the top of the casing there are three or four openings fitted with covers to receive evaporating dishes, and at one end is a curved tube, through which the steam or water vapour escapes. This tube can be connected with a condenser, and then distilled water can be obtained. The apparatus has been neatly made by Messrs. Becker and Co., of 34, Maiden Lane, W.C., and it has evidently been designed by one who not only has a practical acquaintance with what is required, but who also has a knowledge of the scientific principles on which its success depends.



REYNOLDS' IMPROVED OVEN AND BATH.

SIMPLE EXPERIMENTS IN PHYSICS.

TO all matter must be attributed two essential qualities; first, that in virtue of which it occupies space, and which is known as extension; and second, that which allows only one particle or atom of matter to occupy a given space—the property known as impenetrability. That matter occupies space is appreciated by our senses, and needs no particular proof, but that two portions of matter cannot occupy the same space at the same time sometimes seems anomalous, as is shown by some of the following experiments. Into a tumbler filled with alcohol may be crowded a hatful of loose cotton without causing the alcohol to overflow. The success of the experiment depends the slow introduction of the cotton, allowing the alcohol to invest the fibres by capillarity before they are fairly plunged beneath the surface of the alcohol. In this experiment the penetration of alcohol is only apparent; the fibres displace some of the alcohol, but the quantity is so small as not to be observable. If the cotton were compressed to the smallest possible volume it would be found to occupy but very little space. So small a body would be incapable of raising the level of the alcohol enough to be appreciable by an ordinary observer. A more puzzling experiment consists in slowly introducing some fine sugar into a tumblerful of warm water. A considerable quantity of sugar may be dissolved in the water without increasing its bulk.

FIG. 1.—A HATFUL OF COTTON IN A TUMBLERFUL OF ALCOHOL.

FIG. 2.—SOLUTION OF SUGAR IN WATER.

Here the physicist is forced to acknowledge that either the water is penetrated or its atoms are so disposed as to receive the sugar between them, possibly in the same way as a scuttle filled with coals might contain also a bucketful of sand. This latter view is adhered to, and the atom or ultimate particle is held to be impenetrable. In the case of the mixture of water and alcohol, or water and sulphuric acid, a curious phenomenon is presented. Take alcohol and water, for example. Two equal volumes of alcohol and water, when mixed, occupy less space than when separate. If the sum of the volume of the two separate liquids is 100, the volume of the mixture will be only 94. In the case of the mixture of

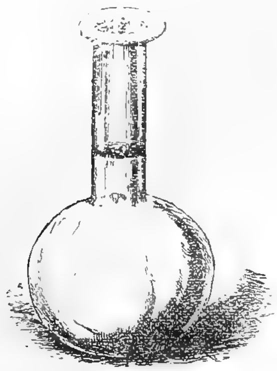


Fig. 3.—Representing Volume of Unmixed Alcohol and Water.

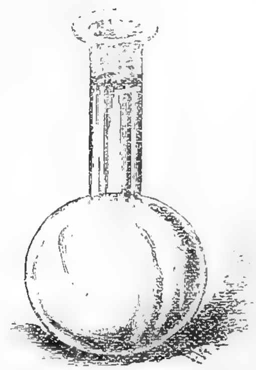


Fig. 4.—Reduction of Volume of Alcohol and Water Mixture.

sulphuric acid and water, the difference is greater. An easy way to perform this experiment is to fill a narrow-necked flask up to a line which may conveniently be marked by a rubber band round the neck, then removing one-half of the water, measuring it exactly, and replacing it with a volume of alcohol exactly equal to that of the water removed. It will be found that when the liquids are mixed, the mixture will not fill the flask up to the original mark. The only reasonable explanation of this phenomenon is that the molecules of the two liquids accommodate themselves to each other in such a manner as to reduce the pores, and thus diminish the volume of the mixture.

THE NUMBER OF CENTENARIANS.

Within the memory of the present generation an able and influential writer, Sir George Cornwall Lewis—not to be confounded with G. H. Lewes—sought to show that there were in modern times no authenticated instances of persons reaching the age of one hundred years. Perhaps the first fatal blow to his theory was given by the well-known case of Professor Chevreul, the date of whose birth has been satisfactorily authenticated, and who has spent the greater part of his 102 years under the eye of the scientific world.

M. Emile Lavasseur has recently made a communication to the Academy of Sciences on the centenarians now living in France, taking his data from the census of 1886.

He admits that there are persons of the age of one hundred years, though their number is less than it is popularly believed. Old men, sometimes, out of vanity, represent themselves as more aged than they really are. Octogenarians who have been consulted as to the age of their senior relatives are led to represent them as older than is really the case, having always known them older than themselves. Thence spring illusions and exaggerations of the number of centenarians.

The head of the Statistical Department of Bavaria was the first to check over the declarations of alleged centenarians by occasion of the census of 1871. There were said to be 37, but on examining the dates of birth there was found only one person, a woman, who had lived for more than a century.

About the same time a similar inquiry was made in Canada, a country which had enjoyed for some time the reputation of longevity. Mention was made of 421 persons said to have died at the age of 100 or upwards, but on close scrutiny only nine persons, five men and four women, were found who had demonstrably lived for more than a century.

In France the first reports sent in, judging from the census returns of 1886, gave the number of centenarians as 184. On the first scrutiny it was found that 101 persons had been wrongly inserted in this category. Of the 83 persons still pronounced to be centenarians, 67 had no more definite evidence than the assertions of their neighbours. Authentic documents, such as certificates of baptism, were found only in 16 cases. Among these is a man (Joseph Ribas) born at San Esteran de Litera, in Spain, and baptised August 20th, 1770, and who consequently was in 1886, 116$\frac{3}{4}$ years. He lives, or at least he was still living, at Tarbes. He was married at the age of fifty, had seven children, and became a widower at 100. If this man has not appropriated the baptismal certificate of an elder brother—which is improbable, since there exist in France documents dating back to a time when he could have no interest in exaggerating his age—he is an authentic instance of an unusually advanced age. The rest, 82 in number, were from 100 to 105 years; a widow was said to be 112 years old, but her age seemed very doubtful.

Women formed the majority (52, women, 37 men). There were naturally few married couples, six celebates of the male sex, and sixteen of the female, twenty-three widowers, and forty-one widows. One of them, aged 103, Madame Rostkowski, born Mazurkiewicz, daughter of a chamberlain of Stanislas II. and sister of a general of engineers, went through the Polish wars as assistant surgeon-major along with her husband, who was captain adjutant-major; she had gone through twelve campaigns, and had been twice wounded. She still lives, on a pension of sixty francs per month allowed her by the French Government. The majority of the centenarians are in a state of indigence. Seven only are in easy circumstances, twenty-two in actual poverty, and the remainder in a very humble position.

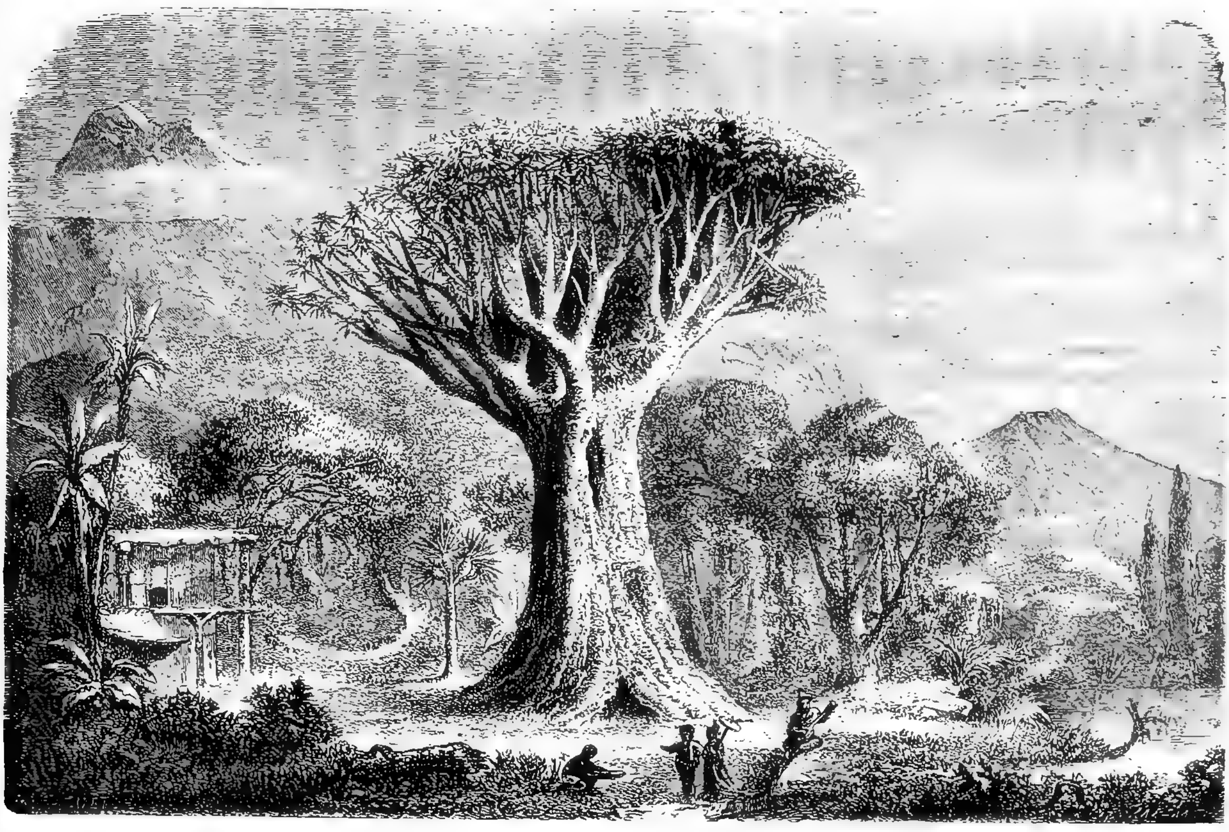
There is no reason to believe that the number of centenarians in France is either increasing or decreasing, and there is no evidence that in past centuries persons reached a higher age than they do at present. For about twenty years the registers of deaths give a yearly average of 73 centenarians, a number probably exaggerated like that in the census returns.

According to these returns more centenarians exist in the south-western departments than in the rest of France. This is confirmed by the registration of deaths, since one-fourth of the centenarians dead from 1866 to 1885 belong to six departments in the south-west. According to a table drawn up by M. Turquan, the basin of the Garonne, from the Pyrennees to the Puy de Dome, contains as many centenarians as all the rest of France. If we, to allow for possible exaggerations, reduce the number of centenarians dying yearly to 50, we find that the chances of a person in the nineteenth century reaching the age of 100 are 1 in 18,800.

Natural History.

THE DRAGON TREE.

THE dragon-tree (*Dracæna draco*) is the chief type of the *Dracænæ*, a genus of endogenous evergreen trees belonging to the natural order of the *Liliaceæ*, and distinguished for the most part by their handsome palm-like appearance. This genus once contained at least thirty-six species, but, it was remodelled and very considerably reduced by Dr. Planchon, who practically only included the dragon-tree species in his new classification. The chief characteristics of the dracænæ are their tree-like stems, either simple or divided at the top, and the crowded heads of long lanceolate leaves, of a powdery olive green, which terminate the branches. The leaves encircle the branches, and as they fall off mark the stem with circular ring-like scars, similar to those described in the article on "Buds" on p. 34 of this volume. The flowers form a terminal panicle, and are individually small and greenish white in colour. In our ordinary greenhouses these plants are most frequently unbranched, being only in the so-called "first age," which lasts, even in their native country, from twenty-five to thirty years. The "second age" is the period of maturity and reproduction, and is of indefinite extent, as is also the "third age," or period of gradual decay. During the second age the original leaf scars disappear to a certain extent, and the thickness of the trunk is increased by the formation of branches, and consequent constant deposit of new matter, while during the third, glandular excrescences and, occasionally, aerial roots are formed. The dragon-tree proper never branches until of very great age, and Humboldt asserts that, both in its size and immense longevity, it closely rivals the baobab in its claim to distinction as the "oldest inhabitant" of our planet. He inclined to the opinion that the patriarchal specimen which he saw in 1799 in the gardens of the Marquessa de Sauzal, in Orotava, Teneriffe, must have been, at the very least, of greater antiquity than even the Pyramids themselves. By comparison of his measurements of this mighty tree with those taken by the French adventurer, Béthencourt, in 1402, he found that the tree had undergone but very slight change during almost four centuries, its slow growth and enormous size thus furnishing an incontestable proof of its marvellous age. The tree in question was first described by the above-mentioned Béthencourt in 1402, who assigned to it the same dimensions as, in later years, Humboldt, Sir G. Stanton, Ledrw, etc., did, viz., a height of from 70 to 75 feet, a circumference, near the base, of 40 or 50 feet, and a diameter of 16 feet at the base, 12 feet at a height of 10 feet from the ground. The trunk tapered but slightly, but rose like a huge rough pillar, comparatively short in proportion to its thickness, dividing at the top into a close cluster of thick branches, terminated by tufts of long, sword-shaped leaves, very tough and leathery, and with a powdery bloom like that seen upon cabbage leaves. The trunk was hollow, and a staircase had been ingeniously constructed inside, reaching up to the roof, if one may so



DRAGON TREE AT OROTAVA.

describe it, formed by the commencement of the branches. A little rustic door guarded the entrance to this strange retreat, which was used by the Spaniards of the island as a chapel for the celebration of holy mass as far back as 1493. Although of such wonderful antiquity, this tree flowered annually, covering its entire crown with a perfect mantle of white blossom, which presented a striking and most poetic contrast to the gnarled and weather-beaten trunk beneath. In 1819 a storm carried away about a third of its branches, but did not seem to affect the main structure very seriously. Unhappily, however, this magnificent specimen of arboreal growth, this living silent record of long-past centuries, was (according to a statement by a recent writer) utterly destroyed by a terrific hurricane in the year 1867. The largest specimen now extant is, we believe, the one outside the gates of the cemetery in the steep little village of Icco del Alto in Teneriffe. As a writer in the *Journal of Forestry* remarks, "The dragon tree has a grim, weird, antediluvian appearance about it, suggestive of the idea that it is a survival of ages past, and that it may have witnessed the struggles for existence whose records are written in the strata of the earth. It was an object of Druidical veneration for centuries before Christianity appeared on the earth, and the hollow trunks of some of the trees were used by early Christians as a place of worship." Tradition asserts that it was deeply revered by the Guanchos, the ancient inhabitants of Canary Isles, who apparently made use of the resin which they obtained from it in the embalming of their dead, since this resin has been found in their ancient sepulchral caves. Humboldt induces this fact as a proof that the Guanchos were not so completely isolated from the natives of Africa and Asia as was commonly supposed, since these trees originally came from India, a question, however, which we have no space to discuss here. Wherever may have been its original home, India or elsewhere, the dragon tree has been cultivated since the most distant ages in the Canary Islands, Madeira, and Porto Santo, and is now never met with farther east than the Isle of Socotra.

The *Dracæna draco* is supposed to have derived its popular name from a red resinous exudation from its leaves and from cracks in its trunk, known in commerce as "dragon's blood," which once formed a considerable export from the Canaries, and which has even yet scarcely fallen into complete disuse. It was formerly used in medicine as an astringent in dysentery, hæmorrhage, etc., but is now scarcely recognised by modern druggists, who use instead the resin of *Pterocarpus draco*, a large South American tree, although that also is now almost out of date, having been superseded by the more modern discoveries and inventions which flood the market in medicine as well as in aught else. The true dragon's blood, or gum dragon, of the present day is mostly obtained from the fleshy fruits of an East Indian palm, the *Calamus draco*, a native of India, Sumatra, the Moluccas, Malay Islands, etc. It is an opaque, reddish-brown resin, brittle and smooth, with a shining shell-like fracture. When burned its odour somewhat resembles that of benzoin; it is almost insoluble in water, but is soluble in alcohol, and the solution thus obtained is used as a permanent stain for marble, leather, wood, etc., and for colouring various tinctures, dentifrices, etc. It is also soluble in oil and turpentine, and in this form is used as a colouring ingredient in clear spirit and turpentine varnishes; and it is used in the preparation of gold lacquer. Another variety of this gum dragon is said to be yielded by the red sandal wood tree (*Pterocarpus santalinus*) of the East Indies, and a somewhat similar substance by the *Dalbergia monetaria*, a tree of the same order indigenous in Guiana. An astringent resin is obtained from the *Eucalyptus resinifera* of New Holland, which is known there by the same name of dragon's blood, and in Mexico another resin of the same kind, obtained from the *Croton draco* (of the order *Euphorbiaceæ*) is still extensively used in medicine.

A New Silk-worm.—Among the silk-producing insects of India *Cricula trifenestrata* should not be overlooked. It is noticed by Mr. Wardle as being very common in Assam, where it is known as the Haumpottonee. It feeds on the "soon" tree, forming an open net-like cocoon of a beautiful yellow colour and of a rich lustre. The silk is spun in the same manner as that of the "eria" cocoon (*Attacus ricini*). It is also met with in Moulmein, where the caterpillars are said to feed upon the cashew-nut tree (*Anacardium Orientale*). This silk-worm is very productive, there being two generations in each year. According to Dr. O. Witt, of Berlin, it yields an excellent fibre, and is likely to prove of importance in the silk trade.

An Advocate of Parasitic Vermin.—According to the *Medical Press*, a Mr. James Grahame actually said in an address to the students at the Glasgow Hospital for Skin Diseases that "the parasites which irritate the cuticle were sent by a beneficent Providence to promote that necessary surface excitement required by the skin, and were not altogether without a beneficial influence on the health of the community!"

Stature of the Extinct Irish Elk, *Cervus megaceros*.—According to a writer in the *Field* the two largest skeletons of this species known (in the Science and Art Museum, Dublin) are respectively 6½ feet and 6¼ feet at the shoulders, the spread of the antlers being 9 feet 2 inches and 11 feet 7 inches. Sir J. Ball states that this species occurred not only in the British Islands, but extended to the eastwards as far as the Altai. Ireland was probably its most recent locality.

A Strange Migration.—The Red Admiral butterfly, which is generally said to be much scarcer in the South of England and in the Midlands than was formerly the case, is becoming very abundant in the North of Scotland.

Hysteria in a Dog?—Mr. T. Byron Place mentions, in the *Field*, that a greyhound bitch suffered for about a month from what seemed to be paralysis. She was unable to move her head, and the whole body was rigid. Whilst on the lawn one day a rabbit started; she immediately followed in pursuit, jumped down the sunk fence, and fell head over heels. She got up perfectly well. This seems to be an instance of the class of recoveries known as "faith cure," "scare cure," or "excitement cure," according to the kind of emotion called into play.

Tracheæ of Hexapods and of Spiders.—J. S. K. (*American Naturalist*) considers the tracheæ of these two divisions of the arthropods not homologous; since in the one they are clearly modified appendages, whilst in the other they occur on segments where well-marked appendages exist.

OUR KNOWLEDGE OF THE BACTERIA.

WE have repeatedly had occasion to refer to the part played by certain of these minute beings in transmitting diseases as well as in originating and keeping up important changes both in living and lifeless matter. It now strikes us that a more systematic description of these beings—avoiding, of course, technical specialities—may be interesting to not a few of our readers. For this purpose we shall avail ourselves, to a considerable extent, of a summary of "bacteriology," contributed to our contemporary, *Humboldt*, by Dr. Carl Günther, of Berlin.

The bacteria are the smallest living beings of which we have any knowledge. They are very widely distributed in nature—a privilege which they owe to the tenacity of their life, the simplicity of their vital conditions, and, above all, to their extremely rapid multiplication. If we wish to make their acquaintance we need merely pour a little water upon some animal or vegetable substance—such as a bit of meat, a little hay, a few peas, grains of rice, a crust of bread—and let the whole stand over-night in a warm place. The water will be found to have become turbid, and, if we examine a drop under the microscope with a sufficiently high power, we shall see a crowd of minute colourless beings of very simple forms. Some of them have the shape of rods, varying greatly both in length and thickness. In length they do not exceed a few thousandth parts of a millimetre (a millimetre, it will be remembered, is 39 hundredths of an inch), whilst their breadth is measured only in the ten thousandth parts of a millimetre.

Besides the rods we find tiny globules, differing in size, and, like the rods, sometimes occurring detached, and sometimes in clusters or united in chains. All these beings, which are at once distinguished by their minuteness from the yeast cells and moulds (which are much bulkier), are called *bacteria*. The little rods are known as *bacilli*, and the globules as *micrococci*. A third form of bacteria, also to be found in infusions, though less plentifully, appear as minute forms, either spirally curved like a cork-screw, or as thin, short, curved rods, and are known as *spirillæ* and *comma-bacilli*.

If we examine such a mixture of bacteria in a recent infusion we see the individual specimens in constant motion. The bacilli and micrococci dance up and down, to and fro, but without any great change of place. This is merely the case of molecular movement, called pedesis, or Brown's movement from its discoverer, and which is always observed in minute solid bodies suspended in liquids. But in addition to this molecular movement, which is common also to lifeless matter, many bacteria are capable of independent motion. This is most distinct in the spirillæ. They screw through the liquid with the speed of an arrow, and then occasionally remain for a time quiescent. Among the bacilli only certain kinds are capable of independent motion, the remainder being, like the micrococci, stationary. The independent movements of the creatures where they exist seem to be executed by means of *flagella*—threads like a whip-lash attached to the extremities of each.

Their reproduction is effected ordinarily by fission. A single individual grows in length, becomes divided transversely in the middle, and is thus resolved into two individuals, each of which is again subdivided in a similar manner. The parts, or the offspring, if we may so call them, may either entirely part company or they remain connected together, forming ultimately chains or links by continued fission. We then call them *streptococci*, or chain-cocci. The bacilli form, in a similar manner, threads. Sometimes bacteria, after fission, remain together in heaps or clusters, apparently adhering together by means of a cement. These clusters are known as *zooglœa*. In some species of micrococci the fission takes place not in one, but in two or three directions. Thus we have groups of four cocci, forming a square, or bale-shaped heaps each of eight cocci, or *sarcinæ*. Among bacilli we sometimes observe under unfavourable circumstances, such as the exhaustion of the nutrient fluid, the appearance of small, shining corpuscules, which are formed within the body of the bacillus. These corpuscules, which are known as *spores* from their analogy to the spores of fungi and algæ, play a similar part to the latter. They are discharged from the maternal body in a shower, and are capable of remaining dormant, if needful, until suitable nourishment is to be found.

Dr. Dallinger, however, in his most recent researches has established that the bacilli do not continue to reproduce themselves by fission, however favourable the surrounding conditions. After a number of successive fissions they seem to become exhausted, and form and discharge a crowd of spores as just described. The enveloping membrane, which is all that remains of the primary bacillus, sinks to the bottom of the liquid, apparently dead.

The spores, set free, if they meet with suitable nutriment, grow up to bacilli, and increase by fission as before.

(To be continued.)

POISONS IN THE WORKSHOP.

(Continued from page 77.)

SINGULARLY enough, the compounds of the metal chromium are often overlooked by writers on poisons. Some of these substances are not less to be dreaded than arsenic, whilst they are used on a very large scale in the arts. The most common form in which chromium occurs in trade is as chromic acid and its compounds with potash and soda. The bichromate of potash forms splendid orange-red crystals, which dissolve readily in water and possess an intensely disagreeable taste. On this account, as well as from its vivid colour, it is little likely to figure as an agent either in malicious or accidental poisoning. The first danger connected with this substance is in its manufacture. We need not here describe the process, but the men employed are liable to suffer from perforation of the cartilage which divides the two nostrils, so that the cavity of the nose becomes single. We do not, however, know that the mischief ever spreads farther, so as, *e.g.*, to attack the palate.

The use of this bichromate of potash in dyeing has its perils. It is consumed to a vast extent in dyeing black upon wool and woollen cloths, which are boiled along with logwood and a certain quantity of bichromate. Of course, the hands of the workmen often get splashed with the liquor, especially when the goods are drawn out of the dye-pans and spread out. Upon some men the solution takes no effect. Others find their fingers becoming swollen and inflamed, and if such continue at this kind of work ulceration sets in, and the fingers or the whole hand might be lost. In all the large dye-works, however, where alone such cases are likely to occur, susceptible men are removed at once to some other department of the works. Thus serious injury from this cause is of exceedingly rare occurrence.

Bichromate of potash is also used along with sugar of lead in dyeing different shades of yellow upon cotton yarns. The liquid used is cold, and the men in consequence touch the material freely with their hands. Either from this cause or from the alkaline nature of the liquid, the hands are more affected than in dyeing chrome blacks upon wool, and cases of impunity are much more rare.

We must, however, remember that certain compounds of chromium, such as the green sesquioxide, are absolutely harmless to prepare and to use. The reason of this is that they are absolutely insoluble, and cannot be volatilized. This is a fortunate circumstance, since the chrome greens (Guïgnet's green) can be used with safety instead of the arsenical greens in the manufacture of wall-papers.

This naturally brings us to arsenic, generally regarded as the most formidable of the mineral poisons. The fact that it is colourless and tasteless, and therefore may find its way unsuspected into articles of food and drink, ought to lead to the abolition of its use wherever there is no absolute necessity. Thus we can see no justification for the employment of arsenical preparations in the manufacture of paper-hangings. Still worse is the case when tarlatans are got up with green arsenical colours, Paris green, Scheele's green, etc., mixed up with starch and not firmly fixed upon the fibre. The air of a ball-room where such tarlatans are worn must contain a certain proportion of arsenical dust.

Now it will be generally admitted that if the wearers of such arsenical tissues and the inmates of rooms hung with arsenical papers are in danger of being attacked, the workmen employed in making such colours or in applying them to the paper and the cloth will scarcely escape with impunity. Now is this, in fact, the case? According to Dr. Jabez Hogg, who has made a special study of the action of arsenical pigments, "workmen while engaged in stripping off old wall-papers from rooms preparatory to re-papering are frequently obliged to leave their work from attacks of diarrhœa and other stomach derangements."

But what must we say of the manufacture, and consequent use, of arsenical pigments where the poison plays no demonstrable part at all in the production of the colour desired? Yet reds, blues, greys, and browns have, on analysis, been found to contain arsenic. Whether this arises from some unscientific method of manufacture or from the careless use of impure materials it is not our place to pronounce.

Arsenic was in former days very generally found in aniline colours. The reason was that magenta was at that time chiefly manufactured by the arsenical process (Medlock's patent), and as a variety of other colours were obtained from its transformations, the aniline colours came to be regarded as, generally speaking, poisonous. To a very great extent this process is now abandoned, and where it is still used the product is purified with such care that arsenic is not to be expected in the aniline dyes sold by the more eminent makers.

Arsenic is used to a considerable extent by calico-printers in the so-called "dung-substitutes." In those styles where a piece of calico is dyed after it has been printed with various mordants it has to undergo a cleansing process, called in France *dégommage*, and in England dunging, because it was performed with the dung of cows suspended in water. To supersede this unpleasant substance, certain preparations were devised, under the name of dung-substitutes, and were composed chiefly of arseniates of soda. Probably none of this arsenic would remain on the tissue to the injury of the future wearer; but the spent liquors and the rinsing waters would convey a certain quantity of arsenic down into the sewers and the rivers, and if not precipitated in an insoluble form would be exceedingly apt to turn up where it was by no means wanted. We forgot to mention that the waste waters from chrome-black and chrome-yellow dyeing also find their way into the streams.

A great channel for the promiscuous distribution of arsenic is the manufacture of sulphuric acid, which is to the chemist what iron is to the engineer—in use always and everywhere. Now, by far the largest quantity of the sulphuric acid of commerce is obtained from iron-pyrites (sulphuret of iron), a mineral which most unfortunately is rarely, very rarely, absolutely free from arsenic. Hence the poison finds unsuspected access into a vast variety of products. A cheap and practicable method of producing sulphuric acid free from arsenic is one of the prizes for which chemists are earnestly striving.

(To be concluded.)

WORK FOR NATURALISTS' CLUBS.

III.—The Structure of a Feather.

It is not easy to find a better subject for an evening's demonstration than a feather. The following materials should be collected:—a few quills, some body-feathers of a fowl, pheasant, or partridge, a peacock's plume, and a fresh pigeon or other bird, unplucked of course. If a lantern can be had, it will be useful to put up between glass plates a piece of the peacock's feather, a double-shafted body-feather of one of the gallinaceous birds named above, an emeu's feather, and also some photographic copies of good drawings. Plate 1 of Nitzsch's Pterylography (Ray Society) is recommended, but various illustrated text-books may be drawn upon for figures of the simpler points. An effective model of the shaft, barbs, and barbules may be made of pieces of card cut to the proper shape, and fitted by means of saw-cuts into wooden bars.

Observe first the primary divisions of a feather, viz., the quill, shaft, and vane. The shaft is occupied by a dense pith; the quill is empty, except for some light and dried-up capsules, which form a chain within it, and which represent the shrivelled remains of the formative follicle. At the bottom of the vane, and on the inside of the feather, will be seen a scar, the umbilicus. Down to this point the originally cylindrical feather has split along one side; below, the tube remains complete. Show by means of a paper model that if a closed cylinder be split open in its upper half, while it remains entire below, a passage into the inside of the tube must exist where the closed and open parts meet. In immature feathers the apex of the formative papilla can often be seen to project from the umbilicus (see figure).

The structure of the barbs which compose the vane may next be considered. Each is a knife-blade, having its thick edge turned outwards, *i.e.*, away from the body of the bird. The barb carries a double row of barbules, which must be shown under the microscope. It will facilitate the demonstration if a piece of the vane of a quill is soaked, first in alcohol, and afterwards in glycerine. Cut out a small bit of the vane so prepared, and tease it with needles as required. Notice the different forms of the two sets of barbules which project from every barb. One set bears hooks, the other is simple or merely notched. The component parts of the vane will be more readily understood if a bit of peacock's plume, with disconnected barbs, is first thrown upon the screen. The barbs and barbules will be clearly seen. After this, it is easy to explain that in the close vane of a quill the barbs lie parallel, each giving off at an open angle close-set barbules. Every barbule crosses a number of others belonging to the next barb, and at every such crossing the uppermost barbule developes a hook, which grasps the barbule beneath. Where the hooks are absent, as in the tail-coverts of the peacock, the feather, though it may serve for covering and ornament, is useless for flight.

Double-shafted feathers may then be described. The accessory shaft (or after-shaft) has the same structure as the principal one, and may be, as in the emeu, of equal length. The primitive cylinder has been split along two opposite lines, instead of one, to furnish the double shaft and vane. The after-shaft is always turned towards the body of the bird. Where the feathers serve only for protection and warmth, as in large flightless birds, it is easy to see the advantage of the double shaft. Twice as many feathers can be crowded into the same surface of skin. But this arrangement becomes impossible when the feathers are directly concerned in flight. They must then admit of being rapidly spread, and also of being neatly folded together when the wing is closed. Accordingly, the quills of the wing and tail in a flying bird never show a vestige of after-shaft.

The pigeon may be used to point out the different kinds of feathers, such as quills, body-feathers, down-feathers, and filoplumes. These last are readily found by plucking part of the breast; they are very long and thin, nearly devoid of vane, and without pith in the shaft. Herons and some other birds have "powder-down patches," consisting of peculiar feathers, which crumble to pieces as fast as they are formed.

The colours of feathers deserve some notice. Pigments, similar to the pigments of hair, can be extracted by a rather troublesome process; the range of colours is not very great, most of the effects being obtained by shades of brown and yellow. Other colours, however, occur, and some of them are very curious. The sealing-wax tips of the Bohemian wax-wing are well known. Still more singular is the Turacin found in the crimson quills of the Touracos, or plantain-eaters. This pigment is soluble in water, and washes off in heavy rain. Many of the iridescent colours found in birds' plumage are not due to pigments at all, but to light reflected from thin films. They are due, in fact, to the same cause as Newton's rings, the iridescence of mother of-pearls, or the colours of the soap-bubble.

Moulting is an interesting subject, which will bring out the knowledge of observant naturalists. Professor Newton's remarks in the article "Birds" (*Enc. Brit.* vol. iii.) will serve as a basis for some preliminary explanations.

The development of the feather must on no account be left out. It is essentially a horny scale, formed out of the epidermis, like the scales of reptiles, but differs from these in being tubular below, and much divided above, whereas the reptilian scale forms a broad plate of simple form. A conical papilla of the dermis, or vascular layer of the integument, supplies the growing feather. The papilla is invested by a double layer of epidermis, pushed inwards from the outside of the body. Its surface is marked by a branched system of sunk lines, which correspond to the shaft, barbs and barbules respectively, and into this mould the nearly fluid cells of the epidermis are forced. The feather is, in short, a horny cast of the surface of the papilla. At first the vane surrounds the conical tip of the cylindrical papilla completely, but it is extremely thin along a line opposite to the shaft, and here it readily separates, opening out into a flattish sheet as it becomes free from the skin. The outermost epidermic layer forms the sheath, which at first adheres strongly to the quill, but is free from the vane. When a feather first pushes through the skin, it is almost entirely hidden within the sheath, from the summit of which a pencil-like bunch of barbs projects. Afterwards the sheath crumbles entirely away. The apex of the feather forms first, and may be quite complete while the base is still pulpy, or altogether undistinguishable. Since the same part of the papilla cannot be used a second time as a mould for the deposit of feather-substance, fresh growth takes place at its base, and the apex of the papilla is gradually pushed upwards. In an immature feather, the tapering and shrivelled tip of the papilla may often be seen projecting from the umbilicus (see figure). After its living substance has been absorbed, the papilla is seen to consist of a chain of inverted conical capsules, joined by a central filament. These cones may always be found within the quill. After the vane has been formed, the surface of the papilla becomes smooth, the horny matter moulded upon it takes the shape of a simple tubular quill, and the feather is complete.

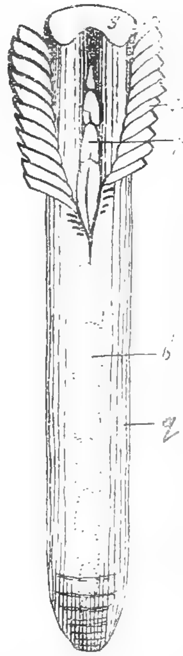


Diagram of a Feather. *s*, shaft, cut short; *b*, bases of barbs; *p*, dried-up papilla, projecting from the umbilicus; *p'*, ditto within the quill; *q*, quill.

THE PURIFICATION OF SEWAGE.—MM. P. Chaotaing and E. Barillot, in a communication to the Academy of Sciences, state that irrigation, a system possessing numerous partisans, is applicable where vast surfaces are available, where the soil is suitable, and where the water to be purified is not heavily loaded with putrescible matters. The chemical procedures, though much decried some time back, deserve the greatest attention in consequence of the improvements already effected, and of those still possible. From the results which the authors quote, it seems distinctly established that the purification of sewage by chemical methods is really efficacious; that it can be applied without interruption and without nuisance, and that the nitrogen and phosphoric acid thus obtained are easily available in agriculture.

Reviews.

Pallas's Sand Grouse (*Syrrhaptes paradoxus*) *; its History, Habits, Food, and Migrations; with Hints as to its Utility and a Plea for its Preservation.* By W. B. Tegetmeier, F.Z.S. London : Cox.

It is rare indeed that any ornithological fact occasions so much general sensation and gives a plea for so much ink-shed as the recent advent of the Asiatic sand grouse. The majority of the British public unfortunately look on birds as mere animated targets created for the edification of the shot-gunner. So long as this feeling prevails the extirpation of any species, aboriginal or immigrating, is averted merely by its rapidity of multiplication or by its being inconspicuous.

Now Pallas's sand grouse, as a novelty, at once attracts attention, and fares accordingly. It visited this country once before, a quarter of a century ago, and was duly extirpated. This year they have reappeared in larger numbers, and earnest efforts, at any rate, are being made for their protection. To such protection it has a fair claim. It is not merely harmless, but positively useful, since its food consists chiefly of the seeds of notorious and troublesome weeds, such as docks, knot-grass, chickweed, and the like. We are sorry, however, to learn that its flesh is edible.

Ornithologically speaking, this bird is the type of a new genus, *Syrrhaptes.* It is distinguished from its nearest allies, the sand grouse of Southern Europe, Northern Africa, and South-western Asia (*Pterocles*) by the peculiar structure of its feet. It has no hinder toe, and the three short, blunt, anterior toes are connected together by a "leathery pad," covered closely with small round wart-like prominences. The legs are short, and on the ground it has a waddling gait, almost like that of a parrot when travelling on a level surface.

The genus approaches most nearly to the pigeons, the grouse, and the plovers, but it is severed from all of them by well-marked characters. It differs from the pigeons by laying three eggs instead of two, and by the fact that the young can pick up seeds as soon as hatched. The want of the hind toe clearly sunders them from the pigeons, the fowls, and the true grouse. Their flight is more rapid and sustained than the grouse, though unlike the pigeons, they do not glide on outspread wings. The bird is not polygamous, and both parents take a share in incubation. The eggs are of a buff colour, with dark-brown spots. The keel of the breast-bone, and of course the pectoral muscles, are very largely developed. Here, as in some [illegible]r species, the greater pectoral, which pulls the wing downwards, is dark, whilst the smaller pectoral is white. Mr. Tegetmeier remarks that this difference between the two pectoral muscles in their colour and texture presents an unsolved problem. In the majority of birds, however, swift in flight no such distinction is found.

The general colour of the plumage of this bird is sandy, barred with brown and black, the sides of the neck and throat orange. On the breast is a narrow band of black-edged feathers, and on the flanks and across the abdomen is a broader and darker band. The back, scapulars, and upper tail coverts are barred with black and dark brown. The wing is remarkably pointed, and the primaries are of a delicate lavender with dark tips. The tail consists of sixteen feathers; the central pair are prolonged at the tip into pointed filaments, extending in the male three inches beyond the others. The female has not the orange at the sides of the neck; the chest-band is indistinct, and the middle tail feathers are less prolonged. The weight of the birds is from $10\frac{1}{2}$ to 11 ozs. The length of the male, from the beak to the point of the tail, is 15 inches; the female is rather smaller.

A difficulty in the preservation of these birds will arise from the circumstance that they deposit their eggs on the sand without any attempt at concealment.

Electricity versus Gas. By John Stent. London : Swan Sonnenschein and Co.

The pioneers of electricity have much to fight against, and those into whose hands this brochure may fall will assuredly cry "Save us from our friends." There is already too much wilful misleading by company promoters and vendors of primary batteries; but here we have an author who candidly informs us that "he is no expert in electrical science." Then *que diable allait il faire dans cette galere?* He appears to make this statement, rather to excuse the absence of technical terms and phrases, than to apologise for his presumption in penning even 79 pages on a subject upon which he has neither right nor title to scribble. He pleads that "he is only one of many who find it necessary to understand enough of what is going on around them, not to be, and to feel, and appear stupid in the presence of discussions in the press, and in conversations that are of common occurrence." With his feelings we have little to do, but we differ most distinctly with the writer as to the amount of knowledge which will save him from being and appearing, not only stupid, but lamentably rash, in venturing to put forth such a work, even at the price of sixpence, without either making a decent acquaintance with the subject itself, or with some one who would revise his proofs, and rewrite a page here and there.

It is interesting to learn that the filament of a glow lamp "is inserted before the globe is exhausted of air." The interest comes in in trying to guess how else it could be done. We are informed that "M. Faure sent a box charged with electric energy from Paris to Sir Henry Thompson in London." We are not in a position to deny that M. Faure was so obliging, and doubtless Sir Henry was gratified, but *the* box which created such a stir in May, 1881, was sent to Sir William Thomson. The extraordinary theory is put forth that the sun would give no light "were it not that the atmosphere is pervaded by countless material particles, which become white hot, and so give us light." The author is not speaking as might be supposed of the sun's atmosphere, for he continues, "If the air were completely purified from all these material particles, the sun might go on shining brightly, but he would give us neither light nor heat. Alpine climbers and balloonists prove the truth of this by finding both temperature and light diminishing as they rise towards the sun, whilst every snow-capped mountain in Switzerland and India and elsewhere corroborates the statement." This wild assertion, "proved and corroborated" though it be, is furnished with the following foot-note: "Phosphorescence hardly comes in under the generic word light." What is probably meant is that in the absence of any atmosphere the sun would blaze as a brilliant ball in a black heaven, but the light and heat would be greater, as every alpine climber can well appreciate.

We are informed that arc lights produce graphite "which is nearly equal in weight to the carbons used and will make a sensible return to the companies producing the light." As a matter of fact, there is a little tip of graphite about the size of half a pea, at the end of the negative carbon of which an inch or so is left, and is worth about as much as the stump of a cigar.

We are not aware if Mr. Stent has studied any other branch of science. His ideas of heat are of about the same standard as his light and electricity. "If the poker be left long in the fire, the extreme end will become hotter and hotter; but if a length of wire or a rod be attached to the rod in the fire, the heat will pass into it, and continue to travel along the wire to almost any distance so long as the one end is hot."

The last page tells us that electricity "is becoming visibly a real light. Its triumph not only over *darkness*, but over all other *forms of artificial light*, is so obvious that," etc. The italics are ours, but that darkness is a "form of artificial light" is a discovery which distinctly belongs to Mr. Stent.

The Architect's Register, being a publication devoted to Art, Architecture, Engineering, Building, and matters pertaining thereto, established to form the nucleus of a Register of Papers read before Architectural and kindred Societies throughout the United Kingdom. Issued Half-yearly. Vol. III. London: W. Pope.

This volume comprises papers on "Old House Work"; on the "Relations of Architect, Surveyor, and Builder"; "Optical Refinements in Architecture"; "Horace Walpole, his Life and Times"; "Notes on some Building Stones"; Theatres and Public Buildings and their Arrangements for Public Safety"; and "Theatre Construction." To the two last we must call particular attention. The former, by Mr. Walter Emden, M.S.A., gives a very elaborate survey of the entire question. From the statistics given it appears that during the past eleven years 2,056 persons have perished from fires in theatres, being a yearly average of 186·9. Out of 252 theatres only three remained for a century without being destroyed.

The author, not unjustly, denounces the present medley of laws for the prevention of accidents as occasioning much hardship to the proprietors without affording the necessary protection to the public. He urges the necessity of legislating for the whole kingdom, and not for London alone, and wishes to place all theatres, music halls, etc., throughout the entire realm in the hands of the Lord Chamberlain, together with funds for carrying out such supervision, on the satisfactory grounds that his office is the only one possessing the knowledge necessary for dealing with the question.

The author then passes to the construction of safe theatres. Very naturally he deals firstly with the means of cutting off the stage from the auditorium, and that with rapidity and completeness. For this purpose he recommends as the best material, asbestos cloth. Iron curtains, from their weight, require powerful and complicated machinery for raising and lowering, and may very conceivably happen to be out of order just when wanted. Here we may mention that Mr. Gordon Hoskins insists on the necessity of raising and lowering such curtains before every performance, and frequently testing them if the theatre be temporarily closed.

The next point discussed is the prevention of panics, and, of course, the supply of safe and easy exits. Here the author contends that there should be two exits from every part of the building, conspicuous, always available, and free from all obstruction, distinct from all connection with other parts of the house, and especially kept well apart from each other. He considers that extra exit stair-cases should lead directly into the street, not into courts or narrow passages leading under or between shops and warehouses.

He advocates the use, in addition to the gas or electricity employed for the general illumination of the house, of a set of lamps fed with vegetable oil to light up the exit doors, corridors, and stair-cases.

Mr. Emden is scarcely fair to the electric light. He says:—"Unlike gas, electricity gives no warning, there is no smell." But in the majority of fires due to gas there is also no smell, because there is no escape. The mischief is due to the decorations, scenery, etc., being by prolonged exposure to the heat of the gas-flames not merely dried to tinder, but rendered in some cases probably spontaneously combustible. At all events, the whole is in such a state that if brought into the most momentary contact with a spark or a flame—which a current of air may occasion—the material is ignited.

The case as between electricity and gas seems to us to lie thus: with electricity there is absolutely no danger if the installation be thoroughly good. But with gas no perfection in the system of piping and no absence of escapes can afford any protection.

Mr. Emden then discusses the use of certain solutions applied to the wood-work, canvas, etc., for rendering them uninflammable. His views here are very judicious. He admits that such a soaking does for a time give protection against the spread of fire, but he raises the unsolved question: for how long? It has, indeed, not been experimentally decided in how far light wood-work, textile materials, etc., soaked in tungstate of ammonia would retain their non-inflammability after a year's exposure to the temperature of 140° F., as is the case with the decorations of theatres where gas is the illuminating agent. He concludes, therefore, that such fire-proofing agents may be useful auxiliaries, but that to depend upon them solely would be "rank madness." In concluding this notice of a very useful memoir we cannot help taking exception to the following passage:—"The stage is still, to a large extent, ignored by the State and by science. Science has, of late years, turned industrial. She makes railroads, steam-engines, factories, and mills; she tins meat and condenses milk; but she has not troubled herself about the stage, and is only now waking to its necessities." We have here the misuse of the term science against which Herschel, Humboldt, Whewell, Grove, Lewes and Crookes have all in turn protested, but, as we see, in vain. Science does not make, tin, or condense anything. She discovers facts, traces out their relations, and reduces them to laws. The utilisation of such facts and such laws she leaves to industrial art, over whose doings and omissions she has no control.

THE UNIVERSITY OF SALERNO.—Mr. G. Foy, F.R.C.S., in a retrospect of some famous Italian Universities, mentioned that the medical schools of Salerno were open to women. Constantia Calenda graduated there as M.D., Sentia Guerna lectured on medicine, Abella Mercurialis practised medicine and published medical works at Salerno. Trottula held a professorial chair in the University.

Abstracts of Papers, Lectures, etc.

ROYAL SOCIETY OF EDINBURGH.

At a special meeting held on the 9th ult., under the presidency of Professor Sir Douglas Maclaren, a paper was read by Dr. T. G. Nasmyth on the air in coal-mines considered especially in regard to its influence upon the health of the miners. Before entering on the results of his own observations he described the condition of ventilation in coal mines twenty years ago, which he showed was such as no miner would now be expected to work in; and said he had been told personally by miners of the air being often so bad that lamps would not continue to burn themselves, but had to be constantly trimmed by small boys, who were engaged for this purpose. Dr. Nasmyth, in his observations, had employed means, which he described, for ascertaining the conditions of temperature, and estimating the amount of organic matter, and for determining the quantity of carbonic acid gas and of micro-organisms present in the mines. He then referred to the means of ventilating coal mines at present in use, the arrangement of downcast and upcast shafts, and the distribution of air to the working faces by branches, instead of the old method of circulating it by a single main gallery, where if an obstruction occurred anywhere it affected the whole of the workings. He pointed out among other defects of the present system that the production of micro-organisms and carbonic acid in the stables rendered it desirable to have these near the upcast shaft. Giving the results of his observations, which in his paper were recorded in a tabulated form, he showed that the temperatures taken at a thousand yards from the downcast shaft differed but little, and that only in the direction of greater uniformity, from the temperature observed in the open air, while he found that the air was nearly always saturated. The tests for carbonic acid showed that a coal mine in this respect was in no worse condition than that of one-roomed houses and badly-ventilated schoolrooms and factories. With regard to the effect of the miner's occupation upon his health, Mr. Nasmyth gave statistics showing the improvement made in recent years in this important matter, and the comparative immunity at present of the miner from chest diseases. In the parish of Brith, the population of which is almost entirely composed of miners, the death rate from pulmonary consumption was upon the average 1·33 per thousand per annum—1·01 among men and 1·72 among women. It was shown from returns for twelve years that the mean age of death was 43·1 among miners.

Summing up, he argued that the state of the air in coal mines was wonderfully good, and, taking into consideration the nature of the products which go to vitiate the air in them, that it would not be easy to ensure its being as good if the work were carried above ground. His own experience was that phthisis was not common among miners, and he knew of no disease either peculiar to them or existing to excess among them. His belief was that the miner's occupation was surrounded by conditions as favourable as those of any other workmen.

At the meeting held on the 16th ult., the Rev. Dr. Flint in the chair, Dr. Traquair read an obituary notice of Mr. Robert Gray, one of the Vice-Presidents of the Society, who died in February, 1887. There was laid on the table a paper "On Some Relations between Magnetism and Twist in Iron and Nickel," by Professor Cargill G. Knott, of the Imperial University of Japan. Professor Crum Brown announced a communication by Mr. Alexander Johnstone on the action of carbonic acid on olivine. Two communications by Mr. George N. Stewart were also laid on the table—the one entitled "Is Talbot's Law True for very Rapidly Intermittent Light?" the other being on certain colour phenomena caused by intermittent stimulation with white light. Lord M'Laren laid on the table a paper on "The Solution of Homogeneous Equations between Variables." Mr. R. Kidston gave a summary of a communication on the fossil plants in the Ravenhead collection in the Liverpool Museum. The plants, he said, had been obtained some years ago by the Rev. H. H. Higgins during the cutting of the railway at St. Helens, near Liverpool, and presented by him to the Museum. Some of them showed a construction which made it difficult to fix their relation to existing species. Dr. H. R. Mill made a communication on the specific gravity of the water in the Firth of Forth and the Clyde sea area. He explained the mode in which the observations had been taken on board the yacht *Medusa* of the Scottish Marine Station, by means of one of the *Challenger* hydrometers. In all, 850 observations had been taken. After showing on a bathymetrical chart the depth of the water in various parts of the Clyde sea area, he explained the distribution of salinity in the region. The observations pointed to the conclusion that the salinity on the surface varied according to the rainfall, and most notably in the districts shut in by high mountains, such as Loch Fyne, Loch Long, and Loch Goil. In those districts where the hills were lower, as in Gairloch, the variations were less pronounced. The saltest surface water in the Clyde occurred, not in the neighbourhood of the sea, but in the Otter Spit in Loch Fyne. Off the Mull of Cantyre the water at the bottom was frequently found to be less saline than on the surface. This occurred in no other part of the system, and was apparently due to the strong tides. Some very salt water was found at the top of the Arran basin, but much depended on the weather in the locality. Mr. Buchan pointed out that the district of which Dr. Mill had spoken was the rainiest part of Scotland. Dr. J. MacDonald Brown read a paper, which he illustrated by the use of diagrams, on "Arrested Twin Development," making special reference to the case of an Indian boy at present being exhibited in this country. In the course of some remarks on concluding the session, the Chairman said it was extremely gratifying that the supply of appropriate papers had never been more abundant than during the session now closed. They had numbered in all 105, or 25 more than those of last session, and had been in every way worthy of the reputation of the Society. The Society had been promised a series of communications on the results of the investigation carried on in the physiological laboratory recently instituted in the Royal College of Physicians, which would be of great value. The membership during the year had increased by the number of 38. After some observations on the aims and objects of the Society, Dr. Flint concluded by referring in some detail to the losses it had entailed by the death of a number of its members, specially mentioning Colonel Balfour, Professor Dickson, Dr. Charles E. Wilson, Robert Chambers, Professor Wilson, and R. Mackie Smith.

SOCIETY OF ENGINEERS.

The members of this Society and their friends paid a visit to the new Precipitation Works at Barking Sewage Outfall, on July 24th, 1888. At the present time the whole of the sewage of the Metropolis north of the Thames is conveyed to Barking Creek by three culverts, each 9 feet high by 9 feet wide, and is, in the first instance, delivered into a covered reservoir divided into four compartments and altogether extending over an area of nine acres. The sewage is stored in this reservoir during eight hours of each tide and discharged into the river at high water at the top of the ebb. This reservoir is situate on the east side of the sewer and immediately adjacent to the river bank.

The new works consist of covered precipitation tanks adjacent to this reservoir on its north side, and occupying the ground between the Outfall Sewer and Barking Creek, an area of between ten and eleven acres. There will be thirteen of such tanks, each 31 feet 6 inches wide and averaging about 1,000 feet long. Communications will be made between the Outfall Sewer and each of these tanks, each fitted with two penstocks, so that communication may be opened or shut off at pleasure.

The sewage will be admitted into each of the tanks in succession, and after being allowed to remain quiescent for a sufficient time to admit of the deposit of the solids in the sewage, the precipitation of which will be expedited by the admixture of 3·7 grains of lime and 1 grain of proto-sulphate of iron per gallon, the effluent will be run off over a weir which will fall as the water in the tank lowers, so that the top film of the effluent only will be taken off, and the tank emptied gradually so as to prevent any disturbance of the solids by the operation.

The effluent after flowing over the weirs (of which there will be ten in each tank) will pass into culverts carried transversely under the tanks and extended, some into the compartments of the existing reservoir, and some into a chamber under the Outfall Sewer through which, at present, the sewage is discharged into the river from the existing reservoirs. When the level of the tide will admit, the effluent will be discharged through this chamber direct into the river, but when the water in the river is too high to admit of this the effluent will be conveyed by the other culverts into the several compartments of the present reservoir, and stored there until the level of the water in the river will admit of its discharge.

When each compartment is emptied of the effluent, the sludge, which will be in a semi-liquid state, will be discharged through culverts passing under the Outfall Sewers into a collecting culvert, from which it will be conveyed by pipes into a receiving well or sump, and pumped into a series of twelve tanks placed side by side and situated between the Outfall Sewer and the river. These tanks will each be 20 feet wide and 140 feet long, will cover an area of over an acre and a half, and, like the precipitation tanks, will be covered so as to prevent nuisance.

The sludge will be allowed to remain quiescent in them so as to allow of a further precipitation, and the effluent water will be discharged over weirs into a culvert which will convey it into a store under the tanks, from whence it will be lifted and discharged through pipes to the liming station, there to be mixed with lime which is used for precipitation.

The settled sludge remaining after this further precipitation will be discharged through culverts into a sludge store situate under the tanks, and will be lifted thence and conveyed by pipes along a jetty, and to a landing stage to be erected in the river, and there discharged into ships which will convey the sludge to sea. In the event of the ships being detained by stress of weather there is a further store for sludge at a lower level extending under the whole of the area occupied by the upper stores.

On the north side of these sludge settling tanks will be erected engine and boiler-houses and workshops in connection, to contain engines and machinery for lifting the sludge in the settling tanks, and the settled sludge into the ships, as well as for pumping the sludge effluent to the liming station.

The lime for assisting the precipitation of the solids of the sewage is introduced in the Outfall Sewers at a point about 700 yards and the proto-sulphate of iron about 530 yards above the precipitation channels.

The liming station will comprise a lime store, floors for slacking the lime, and six tanks for mixing the slacked lime with the effluent water from the sludge settling tanks or with sewage taken direct from the Outfall Sewers, an elevated lime-water tank or reservoir built above the lime store, and into which the lime-water will be lifted by pumps, for which machinery and the requisite engine and boiler-houses will be erected adjacent to the lime stores. From this elevated tank the lime-water will be conveyed to and injected into the sewage passing along the Outfall Sewers, through cast-iron injectors placed in the sewers.

There will be means of turning the lime-water into any one of the three lines of sewers and of regulating the supply by means of sluice-valves fitted to the pipes leading to the injectors. The injectors consist of cast-iron chambers 4 feet 6 inches in length, 6 inches wide and 6 feet in height, fitted with a number of nozzles, through which the lime-water will be injected and mixed with the volume of the sewage as it flows past.

The iron-water station comprises timber sheds for storing the proto-sulphate of iron, a mixing shed in which the iron will be crushed and mixed with water, an engine shed to contain engines and machinery for crushing the iron and mixing it with water, as well as for raising water for boilers and into mixing tanks. The iron-water will be conveyed by stoneware pipes, carried underground and along the top of the Outfall Sewer into a service tank, from which it will be carried by pipes into each of the three Outfall Sewers, and injected into the sewage through perforations in a pipe fixed vertically into each of the sewers. As with the lime-water, there will be appliances for regulating the supply of iron-water to each of the sewers, to meet the varying requirements of the discharge.

There will be a large settling pond, covering an area of $1\frac{1}{4}$ acre, situate near the river, divided into six compartments, each 60 feet by 60 feet, and about 7 feet deep, into which water will be received from the river and allowed to settle; the clear water being afterwards filtered and used for the supply of the several boilers, for slacking the lime, and for mixing with the proto-sulphate of iron.

The jetty, which will extend 576 feet into the river from the present river bank, will be 15 feet wide, and will be a timber structure supported upon piles. At the river end will be a timber landing stage 300 feet in length and 20 feet wide. The iron pipes for conveying the sludge to the ships will be carried under the platform, and will be furnished at the end with a delivery pipe, socketed to admit of a vertical movement, so as to discharge the sludge into the ship at varying levels of the tide. A tramway will be laid along the full length of the jetty connecting it with the whole of the works. The surplus earth from the excavations will be used in forming the banks for the tramways, and in raising the general level of the ground, which is now 6 or 7 feet below the level of Trinity high-water.

The quantity of sewage to be dealt with will amount to about 90,000,000 gallons per day, and the quantity of lime used in precipitation to 23 tons per day.

ROYAL HORTICULTURAL SOCIETY.

At the last meeting of the Scientific Committee a further discussion took place on the Plague of Caterpillars, in the course of which Mr. O'Brien alluded to the abundance of earwigs (*Forficula*) this season. Mr. Wilson drew attention to the local distribution of the caterpillars. In one garden in his neighbourhood none of the pests were found, while in others there was scarcely a leaf left on the trees. At Wisley, Mr. Wilson had found that exposure to east wind was associated with the presence of the insects; thus the trees in one line of plums, fully exposed, were stripped of their foliage, while in another line of the same variety close by, on the same description of soil, but where the trees were sheltered by a furze fence, not a leaf was injured.

From the editor of the *Journal of Horticulture* came a letter written by a Guernsey grower detailing the course of the well-known, or rather these two well-known tomato diseases. The writer's plants were in a span-roofed house, 60 × 25 feet, and were affected last year, when sulphur was applied without effect. After the removal of the crop the grower took the precaution to have the walls washed with lime, to renew the soil, and adopted every known means to secure healthy growth, but this year the disease is worse than before. One grower was mentioned as having seven houses, each 350 × 45 feet, decimated with the disease and not a pound's worth of saleable fruit in them. Mr. W. G. Smith referred to the full description and illustration of the several fungi known to attack the tomato given in the *Gardeners' Chronicle*, in 1881, November 12, and in 1887, August 6, October 1 and 29, by Mr. C. Plowright and himself. Dr. Masters suggested the trial of sulphate of copper in fine powder, mixed with precipitated lime, and dusted over the foliage, as used in the French vineyards.

SCOTTISH METEOROLOGICAL SOCIETY.

At the meeting held on July 24th, Sir A. Mitchell in the chair, Mr. H. N. Dickson read a paper on the "Temperature of the Air and Surface Water of the North Atlantic." The paper gave the results of observations, in the extreme months of February and August, of the area of high atmospheric pressure called the Atlantic anticyclone, of which the centre lies in about 35° north latitude, and of the area of low pressure, whose centre is situated between Greenland and Iceland.

Dr. Buchan submitted a communication on the climate of the Isle of Man, sent by Mr. A. W. Moore, Douglas. In this paper, which contained the observations of fifty years, Mr. Moore arrived at the conclusion that the temperature of the Isle of Man was more equable than that of the surrounding coasts, being somewhat higher in autumn and winter and similar in spring and summer; that there was comparatively little frost and snow, but a considerable amount of raw, damp weather, which to certain constitutions was more trying than a lower temperature in combination with a dryer atmosphere, and that its sunshine was much greater than in the surrounding districts. Its winds were equal in strength and frequency, though felt more in such an exposed place, and its rainfall rather more than on the surrounding coasts.

Mr. Dickson read a note on the earth-currents on Ben Nevis in connection with anti-cyclones, prepared by Mr. R. T. Omond, in continuation of a series of observations begun by Mr. Dickson himself in 1885.

Dr. Buchan then read a paper by Mr. Rankin on St. Elmo's fire, observed at the Ben Nevis Observatory. The writer stated that up to the present only 15 cases of the appearance of the fire had been recorded, and all occurred at night. It was not at all improbable, however, that the phenomena occurred during daylight, its faintness rendering it invisible; indeed, on one occasion it had been heard, the peculiar sound with which it was accompanied having been identified. Mr. Rankin had connected the phenomenon with the prevailing weather over north-western Europe. It occurred in times of depression, when there was an electrical condition of the atmosphere and a succession of cyclones. In almost all cases the appearance of St. Elmo's fire meant not only that a cyclone had passed, but that another was coming, and thus one more had been added to the weather prognostics quietly accumulating at Ben Nevis Observatory.

THE ARTIFICIAL REPRODUCTION OF VOLCANIC ROCKS.

Translation of a Lecture Delivered by M. Alphonse Renard, LL.D., at the Royal Institution.

(Concluded from p. 91.)

Let us consider some of the conjectures about recent volcanic products, suggested to us by this new process, whose delicacy, certainty, and elegance have never been surpassed in any other branch of natural science. It has not only facilitated the verification and control of hypotheses, but has guided them to the ultimate remarkable discoveries, which we will enumerate. Formerly the eye, even when aided by the strongest magnifying glasses, could only detect fairly large mineral crystals in the lava; chemical analysis could often only give the composition of the total mass; the mineral constituents were but guessed at; the mineral texture of the rocks remained a mystery; there was no reliable certainty as to the order in which the elements of the mass had become solidified, or as to the various phases of the crystals, their rough outlines, and primary forms, or the aspect of the rock during its different stages of development. Let us apply the microscope to the examination of a thin slab of lava, rendered transparent by polishing. As we have already seen, lavas may be compared to a glassy mass, but whilst in our artificial glass we endeavour to obtain a homogenous and limpid product, the liquefied matter of the volcanoes already contains at the moment of eruption differentiated substances. The glass which unites them may be regarded as a residue of crystallisation whence numerous individual crystals have extracted their constituents In the volcanic glass, black, brilliant, and opaque, and apparently no longer of a crystalline nature, the microscope discovers a world of mineral forms. It shows us the various periods of their growth, and the cessation of their development caused by the more or less rapid consolidation of the mass. These strangely-formed rudimentary crystals, the first steps of amorphous matter towards a crystalline state, are formed chiefly in those rocks which have retained most of their glassy nature, and which are consequently homogeneous to the naked eye, *e.g.*, obsidian.

Owing to the rapidity with which the glassy paste has solidified, the crystals have been unable to fully develop, and their formation has been brusquely arrested. Hence the embryonic crystals which abound in natural glass, and which receive the name of *crystallites*. Analogous crystals are present in the slag of blast furnaces, bearing close resemblance to those of lava matter. The microscope proves this resemblance, for, on close examination of fine sections of slag, rudimentary crystalline forms are seen closely akin to the crystallites of volcanic glass.

But, as a rule, the crystals do not remain in this embryonic stage. If the lava does not petrify too abruptly, the molecules preserve their freedom of movement, even in a semi-liquid mass, and individual crystals of minute dimensions arise called *microliths*. These microscopical crystals are formed in the heart of the vitreous mass during its gradual solidification. In spite of their infinite minuteness, these little polyhedrons exhibit with marvellous exactitude all the characteristics of their kind, often only fully recognised in far larger specimens of the mineral world, and whose presence in lava would certainly never have been suspected. These microliths in the lava sometimes form a wonderful crystalline network, which gives a special structure to the rock where they are developed, known as the *microlithic structure.*

The dimensions, invariably microscopical, of these microliths, and their disposal in the rocks, clearly prove that they belong to a troubled period, that they were formed at a time when the lava, still in motion, commenced to solidify—originated, indeed, at the actual moment of eruption. Besides these microscopical crystals and these groups of crystallites, which belong to the last stage of consolidation, the lava contains a certain amount of larger and more developed crystals, which can often be detected by the naked eye. These have been formed under calmer conditions, analogous to those presented by a tranquil fluid where crystallisation could take place but slowly. They were formed in the chemical molten bath when it was still hidden in its subterranean reservoirs. This gradual growth is proved by their disposal in concentric zones, and by their dimensions. These large crystals, thrown up in the lava completely formed at the moment of its eruption, are mingled either with the microliths or are contained in a vitreous mass. The upheaval of the mass in which they are held in suspension occurs subsequent to their completed development. The calm is succeeded by a period of agitation, and the violently-ejected lava bruises, corrodes, melts, or crushes the crystals. The microscope shows us distinctly the phenomenon in question—the large dislocated crystals with their fragments dispersed, their edges blunted or worn away, their whole substance penetrated by the paste.

Whilst the physical and chemical agents, started into action by the movements of the lava, thus attack and demolish the ancient crystals, the microliths are gradually forming. The vitreous mass in which the large crystals are suspended, consists of numberless microscopical particles. These are thus connected with a second phase of crystallisation—they are developed in a moving viscous magma,and their ulterior development is arrested by a cooling of the lava so rapid as to cause almost instantaneous solidification.

Moreover, the arrangement of these microliths in the lava clearly proves that this crystalline formation was contemporary with the movements of the lava flow. We notice at once in microscopical preparations that the microliths accumulate round large crystallised sections, and form undulating trails, thus presenting the appearance known among micrographers as *fluid structure.* It is caused by these infinitesimal acicular crystals being arranged in one direction. When these trails of microliths approach an enclosed crystal of large dimensions, they flow round it, stream through the interstices which separate larger sections, and show us the final movement of the mass at the very moment of solidification.

The microscope proves, then, that crystallisation in lava belongs to two periods. During the first, anterior to an eruption, large crystals, already formed, are held in suspension in a mass which we may suppose purely vitreous. In the second, microliths and embryonic crystalline forms appear, which date from the moment of ejection or overflow, and are contemporary with the consolidation of the rock.

Microscopical observations on the crystals of the second period point at once to the conclusion that they were formed purely and simply by igneous process, without taking into consideration either temperatures or hypothetic pressures, two agents hitherto looked upon as chief factors, and without claiming the absolute repose which was one held indispensable for the regular crystallisation of minerals. It is proved that the microliths are formed after the eruption, at barometric pressure, at a temperature by no means so high as was once supposed, and the crystals are even known to form during the actual movements of the lava stream. When the cooling is very abrupt there is no time for microliths to form, and the lava matter only produces crystallites.

But the microscope enable us to determine the chronology of these lava crystals with even greater exactitude. We have just remarked two great periods in their history; let us see how we may, to a certain extent, determine the date at which each of the specimens of the two groups became isolated from the glass.

The particular circumstances which lead to this determination of their relative ages are their enclosures.

A crystal which is developed from a vitreous mass frequently accumulates particles from the medium in which it is embedded. Thus certain sections appear, under the microscope, riddled with vitreous grains imprisoned in the heart of the crystal, and often arranged according to the zones of development. These enclosures sufficiently prove that that the crystals in question are formed from a vitreous matter liquefied by heat. In other cases, there are mineralogical specimens which are found, in the form of microliths, in the interior of a crystal. It is thus evident that these microliths are of earlier origin than the mineral which imprisons them. Finally, in yet other cases, sharply defined crystals are found covered with another specimen which fills up all the interstices between the previously formed mineral, an incontestable proof of the priority of the crystal. With the aid of these convincing facts, chronological lists have been obtained showing the state of crystallisation of each species of the two great periods. We have not space to quote them here, but we get glimpses of the law, discovered by synthetical experiments, which governs the formation and the relative ages of crystals. We have only drawn the outline of the history of lava; but, although we have been unable to do more than sketch in certain of the details of this representation of lithological phenomena, which modern investigations have delineated with such startling fidelity, we have indicated enough to amply and forcibly prove the great capabilities of analysis as a coadjutor of thoughtful reasoning. From this standpoint the study of lava, such as we are endeavouring to interpret, presents surely one of the finest possible examples of the application of inductive methods to natural sciences. We scarcely know what to admire most, the process of analytical operations, the skill of the observers, or the logical chain of thought by which the phenomena are connected. By this powerful mode of investigation, microscopical analysis, we are enabled to trace with minute exactitude the process of crystallisation in a rocky mass where the naked eye fails to detect anything but an indistinct uniformity, to penetrate into this wonderful tissue of volcanic products, which contain millions of polyhedrons in a cubic centimetre, to determine with mathematical precision the nature of each of these infinitesimal bodies, to follow them from their origin through their entire development, and to mark the traces of all their modifications by chemical and physical agents.

(*To be continued.*)

CORRESPONDENCE.

The Editor does not hold himself responsible for opinions expressed by his correspondents, nor can he take notice of anonymous communications. All letters must be accompanied by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

A CIRCLE PROBLEM.

As some interest seems to have been manifested in this "catch for the unwary," perhaps I may be permitted to hint to "A. P. T." that a neater way of putting the statement, and one, sounding, too, more astonishing, is to omit altogether the qualifying parenthesis "unless the circles are many thousand miles in diameter,"—and to say (instead of the subsequent sentence): "The difference *will never be greater than* the circumference of a circle 18 feet in diameter." In fact, owing to the rotundity of the earth, the greater the circles, the less will be the difference between them. Their greatest possible circumference would be attained if they were made to encircle the earth exactly at the Equator, and then their difference would entirely vanish, and they would be equal.

M. A. I.

AURORA BOREALIS.

I never saw it recorded that any one had heard this phenomenon, neither have I, although I have seen the entire sky illuminated with the streaks of light, shooting from the northern horizon, with little apparent diminution, to the southern; but a retired ship captain here informs me that he and others with him often heard a crackling noise accompany it, or a sound resembling sheets of tin being rattled together, particularly near the banks of Newfoundland.

North Shields. T. TODD.

RECENT INVENTIONS.

The following list has been compiled especially for the SCIENTIFIC NEWS *by Messrs.* W. P. THOMPSON *and* BOULT, *Patent Agents, of* 323, *High Holborn, London, W.C.; Newcastle Chambers, Angel Row, Nottingham; Ducie Buildings, Bank Street, Manchester; and* 6, *Lord Street, Liverpool.*

LAMP.—A mineral-spirit lamp has been patented by Mr. W. H. Beck on behalf of Mr. O. Proust. The burner is constructed by means of two combined tubes sliding one in the other to effect the raising and lowering of the wick. A tube perforated throughout its length contains and conducts the wick to the lamp, and thus puts it by means of openings in contact with sponges saturated with the mineral spirit, and leaves it constantly free to be operated on by the regulating apparatus of the burner.

ELECTRIC CLOCK.—An electric clock has been patented by Mr. J. G. Lorrain. The invention consists in the combination of an electromotor capable of being actuated by continuous currents, and rotating at each transmission of the electric current, and a detent serving to arrest the movement of the electromotor when it has travelled through its required distance, and to allow it to make its next movement in the same direction as before, when the next transmission of electric current takes place.

BATTERIES.—An electrical battery has been patented by Mr. C. P. Elieson. The invention consists in the combination of two hollow electrodes of any form, adapted to be placed one within the other. In the case of secondary batteries each electrode is composed of a series of plates of metal superposed, but separated from each other by interposed pieces of suitable porous material, all the plates being secured in position by rods or suitable means. In the case of a primary battery the electrodes are built up in a similar manner, except that the porous material is not required, the plates being kept separate by distance pieces.

ADVERTISING.—An apparatus for exhibiting advertisements has been patented by Mr. F. Schoyer. The apparatus is contained in a box glazed in front, through which the advertisements are seen. The advertisements are made into a continuous sheet and passed round rollers, so that it is held distended where it appears opposite the glass front, but where it is out of sight it is allowed to accumulate in folds. On the periphery of the upper rollers are fixed pegs, which engage in eyelets made at regular distances apart in the advertisement-sheet, so that when the rollers are revolved by means of a handle or other motive power, automatic or not, the advertisements appear in view successively as the sheet is drawn forward.

FILTER.—A pocket filter has been patented by Messrs. S. W. Silver and W. S. Bennett. This filter is so constructed that when not in use it can be folded up and carried in the pocket. It consists of a box with a perforated base, the inner surface of the base being covered by a piece of flannel on which is placed a block of charcoal which has another piece of flannel placed on top of it. This latter piece has a hole in its centre for the block nozzle to project through to enable the suction tube to be attached. A screw cover rests upon the top flannel below the top edge of the box to leave room for receiving the suction tube when coiled, this being kept there by means of an outside cover, and can then be placed in the pocket. The inner cover is perforated, so that when in use the water has access to the block both from top and bottom.

Garment - measuring. — An apparatus for taking measurements for garments has been patented by Mr. J. Couteau. The invention consists of what may be termed a conformator, to be placed upon the body of the person to be measured. It is composed of pieces of cloth arranged exactly in the same manner as those which will constitute the garment to be made; but instead of the different pieces being sewn together, they are attached to each other by slide plates, so that the different parts of the conformator can be drawn together or pulled apart until it is suitably fitted to the person. The slide plates are marked with scales which, after the fitting, are copied on paper patterns, which have numbered lines corresponding with the plates of the conformator. In cutting the patterns according to the marks thus made exact plans of the different parts of the garment are obtained.

Pianofortes.—A repeating action for pianofortes has been patented by Mr. A. Seppe. The mechanism is as follows: The hopper has a swinging lever, one end of which has a cushion to keep the hammer in suspense when the top end of the hopper is driven out by the stop cushion from beneath the hammer. To the *other* end of this lever is fixed a cushion on a regulating screw and a spring. The upper end of this spring is passed through a projection of the hopper, whilst its lower end passes round a pin set in the lever, and bending upwards, bears against the regulating screw. Thus by means of the regulating screw the tension of the spring can be regulated with precision and the hammer balanced to the required degree. The upward stroke of the horizontal end of the lever is limited by a hook on the end of a screw fixed in a horizontal block fixed to the back of the hopper. The downward stroke is limited by the cushion. A third regulating screw secures mathematical precision in the hammer leaving the string at the moment of the stroke.

Alarm Gun.—An alarm gun has been patented by Mr. E. Drinkwater. This gun instead of firing once only, explodes several times in succession, thus more clearly denoting to the person listening from which direction it is fired. It consists of a metal box having at one side a series of chambers at the inner ends of which are holes communicating with the interior of the box. The chambers each contain a charge of gunpowder, which is fired successively by means of a fuse designed to be ignited upon the explosion of a cap. The fuse is mounted on a bar having arms which enter the communicating holes; at the end of each arm the fuse is slit, so that when ignited it will fire each charge. The end of the fuse is placed in a small box upon which is a nipple for carrying a cap. Close to the end of the fuse is a small quantity of powder, so that when the detonator is fired the fire will pass through the nipple, ignite the powder, and then the fuse. The detonator is fired by means of a hammer held up by a plate supported by a catch to which is attached the wire drawn round the part to be protected. When this wire is pulled by any means the hammer falls and the alarm gun fires.

TECHNICAL EDUCATION NOTES.

Proposed Technical and Recreative Institutes for North London.—Last week a deputation of gentlemen interested in the movement of technical and recreative institutes in the boroughs of Finsbury, Hackney, Islington, and St. Pancras, had an interview with Mr. Anstie, Q.C., one of the Charity Commissioners.

Sir A. Rollit, in introducing the deputation, said that in the boroughs of Finsbury, Hackney, Islington, and St. Pancras movements had taken place in favour of the establishment of technical institutions and polytechnics, committees had been formed, and considerable funds had been promised. The parishes now came unitedly before the Commissioners for the purpose of suggesting a scheme which they considered was of a fairly definite character. They thought it was necessary to have at least four institutions on the general lines of the Polytechnic in Regent Street, one for each of the four boroughs.

Mr. R. Chamberlain, M.P., asked whether, after the boroughs had raised as much money as they possibly could, the Commissioners would put a benevolent interpretation upon the pound for pound principle, and would not deny to the different localities the benefit of these technical institutes because they had not been able to raise so much as 20s. for every pound which the Commissioners were prepared to give. If the pound for pound rule were rigidly insisted upon, it would mean that the richer the locality the greater amount of charity would be bestowed upon it.

Mr. Bartley, M.P., said he did not agree with the general view of forming a general committee and a common fund for the whole area. He thought these great boroughs were big enough to have schemes for themselves. If they were boroughs in the country they would be treated separately.

Mr. Anstie said, in reply, that as the deputation did not appear to have absolute unanimity it would perhaps not be very wonderful if the Commissioners found their schemes did not please everybody. He could not answer all the questions that had been put to him, as he was only there to hear their views, but with respect to the pound for pound principle it was a little hard upon the Commissioners that, having in that respect shown themselves open to receive suggestions, they should now have advanced against them the charge that they were imposing some objectionable terms upon the metropolis at large. The principle of pound for pound was suggested by South London, and had been accepted by the Commissioners throughout, as they thought it a very reasonable proposal. Chelsea—not the borough of Chelsea, but the south-western district of London—had also accepted the principle. This mode of dealing with the matter had proved thus far eminently successful. South London was getting on very well, although there was not, he believed, a poorer district in the metropolis. The Victoria Hall had collected its pound for pound, and the Elephant and Castle was getting far on its way; therefore, so far as experience went, he could not see any objection to the very business-like proposal of South London. He did not think it would work at all ill in North London, provided North London did what South London had done and was doing; but if North London was to be split up into a number of hostile camps, then he did not quite see how that district was to be worked. With regard to the position of these institutions it would be impossible to fix them in the poorest quarters, because those were sometimes the most inaccessible parts of the parish, and to place them there would prevent them from being at all successful. He might mention that the Commissioners had before them a proposal of an extremely good kind, which he hoped would facilitate the foundation of some such institute at Clerkenwell, which might be considered as one of the most suitable places in London for such an institute. That proposal had not been made by the poor inhabitants of Clerkenwell. It had been made on behalf of persons who were not resident in Clerkenwell, but who were generous and wealthy. He mentioned that to illustrate the absurdity of the notion that because this business-like proposition of South London had been accepted by the Commissioners as a working basis, therefore it meant that an institution must be established in Grosvenor Square, or in some other of the most wealthy districts. He would like to ask the deputation where the money for four institutes was to come from. A large technical and recreative institute such as that contemplated would cost £100,000. There must be a large and costly apparatus, not only as regards teachers, but also for materials and workshops; in fact, technical education cost about ten times as much as what might be called the common literary education. He would strongly express a hope that North London would establish an executive committee similar to that in South London. It was far better to put down one institution on solid and good foundations than to attempt to put down two or three in an infirm and crippled condition. With regard to the collection of the money, he might tell them that the Polytechnic boys collected £3,000 between them.

SALES.

The Charge for Advertisements in this Column is Sixpence for the first sixteen words, and Sixpence for every succeeding eight words. Advertisements for this Column should be received by first post on Tuesday to insure insertion in the following number.

Beautiful Model Beam Engine.—½-horse; strong, riveted, copper boiler; constructed for gas; Bunsen burners; water tank; all fittings; splendid order.—Offers to JOHN LOW, 9, Braid Place, Edinburgh.

Wanted, by two experienced Mechanics, Model Work to do at home (Mechanical or Electrical). Specialities and ideas worked out to drawings, scale, or size. Good workmanship guaranteed. Moderate terms.—P. R., 40, Westbury Street, S.W.

Practical Hints on Electro-Plating, etc. One stamp.—Address, HENRIC, 234, Great Colmore Street, Birmingham.

Amalgamating Brushes, Scratch-brushes, Polishing Sand, Calico Mops, Rouge and Crocus Compositions, Nickel Salts and Anodes.—HENRIC, 234, Great Colmore Street, Birmingham.

Fretwork, Carving, Turning, Woods, Tools, and all requisites. Catalogue with 700 illustrations, 6 stamps.—HARGER, BROS., Settle.

Do your own Electro Plating and Gilding. System inexpensive. Particulars one stamp.—PERKS, 47, Alexandra Road, Richmond, Surrey.

Steel Name Stamps, 3d. per letter. Figures (set), 2s. 4d. Post free.—F. BALDWIN, Tuffley, Gloucester.

Meerschaum and Briar Pipes Repaired, Mounted, or Cased, ambers fitted.—W. GEORGE, 324, Essex Road, Islington, London.

Minerals, Fossils, Cretaceous, Liassic, Carboniferous, Silurian. 12 named specimens, 2s. 6d. free—CHAS. WARDINGLEY, Blackwood Crescent, Edinburgh.

Aquarium Plants, Valesneria; 8 dozen Snails, Newts, etc., cheap, post free.—SAMUEL NEWTON, Hollow Stone, Nottingham.

"Precautions on Introducing Electric Light," Fire Risk Rules, Glossary, by KILLINGWORTH HEDGES, Consulting Electrical Engineer; 1s. 2d. post free.—GLOBE ELECTRICAL COMPANY, Carteret Street, S.W.

EXCHANGES.

Exchange Notices will be inserted in this Column at the rate of Sixpence for the first twenty-four words, and Threepence for every succeeding eight words.

Advertisements for this Column should be received by first post on Tuesday to insure insertion in the following number.

Splendid Solar Microscope, in case, by Nairne, six powers. Exchange photographic apparatus.—RIDOUT, Sunbury Common.

100 Geological Specimens, named. Exchange, 10s. Approval.—HOLDEN, Hoyland Nether, Barnsley.

I offer Lawn Mower, 52-inch Bicycle, Lockstitch Sewing Machine, or Fret-Saw and Lathe, cost £5 5s., in exchange for Lathe.—Wellesley House, Colchester.

SELECTED BOOKS.

Handbook of the Amaryllideæ. Including the Alstrœmerieæ and Agaveæ. By J. G. Baker, F.R.S., F.L.S., First Assistant in the Herbarium of the Royal Gardens, Kew. London: Bell and Co. Price 5s.

Electro-Plating. A Practical Handbook on the Deposition of Copper, Silver, Nickel, Gold, Aluminium, Brass, Platinum, etc., with descriptions of the Chemicals, Materials, Batteries, and Dynamo Machines used in the Art. By J. W. Urquhart, C.E. Second Edition. London: Crosby, Lockwood and Sons. Price 5s.

NOTICES.

The Title Page and Index to Vol. I., now ready, price 3d.

Binding Cases for Vol. I., price 2s. each.

Cases and Binding, Vol. I., including Title Page and Index, price 3s.

Vol. I., bound in cloth, with Title Page and Index, 9s. 6d. —by post 10s.

The Back Numbers of SCIENTIFIC NEWS can be obtained from all Booksellers and Newsagents, or direct from the Publisher, 138, Fleet-street, London, E.C. Price 3d. each, or by post 3½d.

METEOROLOGICAL RETURNS

For the ten weeks ending on Monday, July 23rd, 1888. Specially prepared for SCIENTIFIC NEWS from official reports

	Mean Temperature.	Rainfall.	Duration of Sunshine.
Scotland, East	51·2 degs., being 2·8 degs. below average.	8·1 ins., being 1·6 ins. above average.	407 hrs., being 23 hrs. below average.
England, N.E.	52·0 ,, ,, 3·7 ,, ,, ,,	6·7 ,, ,, 1·6 ,, ,, ,,	319 ,, ,, 113 ,, ,, ,,
England, East	55·3 ,, ,, 2·6 ,, ,, ,,	5·9 ,, ,, 0·9 ,, ,, ,,	346 ,, ,, 164 ,, ,, ,,
Midlands ...	54·8 ,, ,, 2·7 ,, ,, ,,	7·1 ,, ,, 1·6 ,, ,, ,,	325 ,, ,, 123 ,, ,, ,,
England, South	55·0 ,, ,, 2·2 ,, ,, ,,	6·7 ,, ,, 2·4 ,, ,, ,,	340 ,, ,, 132 ,, ,, ,,
Scotland, West	53·5 ,, ,, 1·0 ,, ,, ,,	9·9 ,, ,, 3·4 ,, ,, ,,	397 ,, ,, 32 ,, ,, ,,
England, N.W.	54·4 ,, ,, 2·4 ,, ,, ,,	7·1 ,, ,, 0·2 ,, ,, ,,	364 ,, ,, 87 ,, ,, ,,
England, S.W.	55·4 ,, ,, 1·9 ,, ,, ,,	7·1 ,, ,, 1·7 ,, ,, ,,	409 ,, ,, 74 ,, ,, ,,
Ireland, North	53·9 ,, ,, 1·9 ,, ,, ,,	9·0 ,, ,, 2·7 ,, ,, ,,	375 ,, ,, 12 ,, above ,,
Ireland, South	55·8 ,, ,, 1·1 ,, ,, ,,	9·1 ,, ,, 2·9 ,, ,, ,,	401 ,, ,, 3 ,, below ,,
The Kingdom...	54·1 ,, ,, 2·2 ,, ,, ,,	7·8 ,, ,, 1·9 ,, ,, ,,	368 ,, ,, 74 ,, ,, ,,

The above period encloses the first ten weeks this year wherein the rainfall for each division of the Kingdom has been above the normal; during the corresponding period of last year the rainfall for the Kingdom was 2·6 inches below the normal, and the sunshine value 50 hours above.

Scientific News
FOR GENERAL READERS.

Vol. II. | FRIDAY, AUGUST 10th, 1888. | No. 6.

CONTENTS.

SCIENTIFIC TABLE TALK.

By W. Mattieu Williams, F.R.A.S., F.C.S.

Many still assume, as a matter of course, that all colliery explosions result simply from fire-damp, though Faraday and Lyell, in the *Philosophical Magazine* of 1845, reporting on their examination of a mine in which a great explosion had occurred, told us that "the coal-dust swept by the rush of wind and flame from the floor, roof, and walls of the works would instantly take fire and burn if there were oxygen enough in the air present to support its combustion; and we found the dust adhering to the face of the pillars, props, and walls, and in the direction of and on the side towards, the explosion increasing gradually to a certain distance as we neared the place of ignition. This deposit was in some places half an inch, in others almost an inch thick; it adhered together in a friable coked state."

An examination of this deposit showed that it consisted of partially burned coal-dust, which had been deprived of the greater part of its inflammable bitumen—was in some cases entirely destitute of it. Faraday and Lyell concluded that this coal-dust had been ignited, and the extent of its combustion was limited by the supply of oxygen—that "much of the carbon of this dust remained unburnt only for want of air."

Mr. W. Galloway has more recently and quite independently studied this subject very exhaustively, and has proved that in many mines the dust is more dangerous than the gas. The practical importance of the knowledge which his researches have supplied is very great, even greater than most mining engineers and other experts, who only take into consideration the present operations of coal-mining, suppose.

I base this opinion on the fact that we are rapidly exhausting all the workable coal that exists at moderate depths, and must go on sinking to deeper and deeper seams until we are stopped altogether from further working, not by the exhaustion of the coal, but by the high temperature rendering the operations of workmen, and even the working of coal by machinery, impossible.

When we get below a certain depth, which varies greatly with the locality, the supply of water, which in ordinary pits costs so much to remove, ceases; the roads and workings become dry, and as every stroke of the pick produces a certain amount of coal-dust, the accumulation soon becomes considerable. The danger of such accumulation is increased by the high temperature of the seam itself, of the rock in which it is embedded, and of the atmosphere of the workings.

That an accumulation of dust may produce fearful and fatal explosions without the aid of any fire-damp, or any other explosive gas, has been proved again and again by destructive explosions in flour-mills, although the carbohydrates of the flour are less inflammable than the hydro-carbons of the coal-dust; but, on the other hand, the flour-dust is finer and lighter than ordinary coal-dust. In the "Annales des Mines" for 1875 M. Vital describes very minutely all the particulars of an explosion in the Campagnac Colliery, 2nd November, 1874, where a shot which blew out the tamping produced an explosion that was fatal to three men. No fire-damp had been detected there at any time, but the floor was covered with very fine, dry coal-dust, the shot was fired at the bottom of the face, and would thus raise a cloud of dust from the floor. Other similar cases are recorded.

The negative evidence in these cases is, however, not always reliable. It is usually based on the behaviour of the Davy lamp. The presence of fire-damp is indicated by a "cap," which is a conical blue flame, more transparent than the oil flame, and appearing to rest upon it. The height of this cap varies with the quantity of fire-damp mixed with the air. Mr. Galloway made a series of experiments with measured artificial mixtures of these, using a lamp-flame drawn down to about $\frac{1}{8}$ inch high by $\frac{1}{4}$ inch diameter at the base, and with only a conical speck of yellow in the middle near the top (conditions most favourable for showing a small cap). He found that 1 part of the inflammable gas to 16 of air gave a voluminous, waving, spindle-shaped, pale-blue cap $3\frac{3}{8}$ inches high; with 1 to 18 a similar cap 2 inches high, which burned rather more steadily; 1 to 20 a cap $1\frac{5}{16}$ inch high, with nearly parallel sides to about two-thirds of its height, and drawn out to a point at the top; 1 to 25 a conical cap $\frac{1}{2}$ to $\frac{5}{8}$ of an inch high; 1 to 30 a conical cap $\frac{3}{8}$ of an inch high; 1 to 40 a conical cap $\frac{3}{16}$ to $\frac{1}{4}$ inch high; 1 to 50 an exceedingly faint cap $\frac{1}{8}$ of an inch high, the top having the appearance of being broken off; 1 to 60, hardly possible to distinguish anything above the oil flame. The colliery firemen to which this latter was shown "asserted positively that they would consider an atmosphere in which the small oil flame burned as it did in this mixture to be *perfectly free from gas*."

It is evident from these experiments that, in the ordinary course mines may be reported to be free from fire-damp in which the air is mixed with 1 part in 60 or any smaller proportion.

Mr. Galloway found that ordinary coal-dust mixed with air only is not inflammable at ordinary pressure and temperature, but that if air be mixed with fire-damp in proportions of one in 112 and in greater proportions it becomes inflammable at ordinary pressures and temperatures. From these results, together with those of his experiments on the lamp-flame, it is evident that mines with an atmosphere containing any proportion of fire-damp between $\frac{1}{112}$ and $\frac{1}{60}$ may be reported free from fire-damp, and yet be very dangerous, owing to the combined operation of the coal-dust and the small proportion of hydro-carbon gas. This may have been the condition of the Campagnac Colliery above referred to.

There is a curious fact connected with colliery explosions in dry mines, which at first glance appears mysterious, but which is readily explained when the potency of coal-dust in producing them is understood. It is that they occur most frequently in the winter months when the air is coolest.

This is due to the fact that in coal-mines generally the temperature below is subject to very little variation. It is regulated by the rock temperature, not by that of the atmosphere above ground. I knew an old collier in Flintshire who had saved enough to buy a small freehold and retire, but who worked below in the winter for comfort's sake, or, as he said, for the benefit of his health, just as more luxurious patients winter at Mentone or San Remo. To explain this let us suppose the case of a deep pit at 70 degs. Fah. With the summer air above ground at 70 degs. and saturated with aqueous vapour, it will remain thus saturated below; but in winter the air, say at 40 degs. and also saturated, will when raised to 70 degs. below acquire a proportionately increased capacity for water, and will be very dry and thirsty, taking water from everything it touches that is at all damp. It will thus render the loose dust excessively dry, and thereby increase its inflammability.

It will be further understood from the above-stated facts that thorough ventilation, which is the best safeguard against the accumulation of fire-damp, may contribute to the explosiveness of coal-dust.

It is evident, therefore, that in working the deeper collieries of the future our mining engineers will have to study these modified conditions of danger, and make arrangements accordingly. The watering of mines will become as necessary then as the pumping is now; such watering will be demanded not only for laying the dust, but also for lowering the temperature of the workings.

Volcanic Eruption in the Lipari Islands.—On August 3rd an eruption occurred in these islands, on which the well-known volcano of Stromboli is situated. Immense damage is stated to have been caused by the eruption, but no details have reached here owing to the destruction of the telegraph communicating with the islands.

REPRODUCTION OF ARTICULATE SPEECH AND OTHER SOUNDS.

THE transmission of articulate speech, wonderful and useful as it is, is fully equalled in point of novelty by the instrument for recording, preserving, and producing speech. Without doubt these "speech reproducers" are destined sooner or later to take a large place in business and social transactions. No one who has given the matter a moment's thought will fail to see the utility of a practical machine of this sort. Leon Scott long ago devised a simple and curious instrument known as the phonautograph, in which the vibrations of a diaphragm were recorded by a stylus upon a smoked cylinder, but it is now known that its record was not autographic, although it conveyed a fair idea of the number and variety of air waves necessary to the production of words and sounds. Faber's talking machine is curious and interesting on account of being a mechanical imitation of the vocal organs. It is capable of producing articulate speech by the manipulation of a bellows and key. The first machine to really echo one's own words was the Edison phonograph, which, as originally presented, was not sufficiently effective in its operation to be of any great commercial value, although it contained the germ of the modern talking machine. The graphophone, which is shown in the annexed engravings, is, as its name indicates, a recorder and reproducer of sounds. It is the invention of Mr. Charles Sumner Tainter, and is the result of several years' experimentation and the subject of many patents, several of which were issued in May, 1886. In its construction efficiency has, of course, been the first consideration, after which the matters of simplicity, facility of management, and the practical handling of the records or messages have been disposed of. The machine is an exceedingly simple thing. Fig. 1 shows it as arranged for receiving or recording the message. The frame of the machine consists of end pieces connected by longitudinal rods. In the top of the frame is a fine screw partly enclosed by a tube; the screw is driven through a train of spur wheels attached to the main shaft, which is also provided with a conical chuck. At the opposite end of the frame is a spindle acted on by a spring, which also carries a conical chuck of the same form and size as that on the main shaft. The cylinder upon which the speech is to be received is placed between these chucks in much the same manner as the bobbin is placed in the bobbin winder of the sewing machine, the cylinder being revolved by the frictional contact with the chuck on the main shaft. At the right hand of the instrument is arranged a small rock shaft provided with a cross arm and two keys by which the driving wheel is thrown in and out of connection with the gearing of the machine. On the tube which encloses the feed screw is placed a saddle provided with a follower which enters the slot of the tube, and engages the feed screw. The saddle carries a diaphragm cell, in which is arranged a diaphragm provided with a cutting stylus which engraves the record on the surface of the cylinder. To the diaphragm cell is attached a bar or bridge piece of metal, which extends across the face of the diaphragm, but not in contact with it. This device rests upon the record cylinder a little in advance of the cutting stylus, and supports the weight of the diaphragm cell and its attachments. The depth to which the stylus penetrates the surface of the cylinder is regulated and maintained by this arrangement, and as the bridge-piece bears upon the cylinder near the point of the cutting, the apparatus follows all the irregularities of the recording surface, and perfect accuracy in centering the cylinder is rendered unnecessary. To the diaphragm cell is attached a flexible tube furnished at its free end with a mouthpiece, into which the words to be recorded are spoken. The record cylinder consists of paper wound in cylinder. The machine is driven by connection with any power having a fairly uniform speed: In the engravings the machine is represented as being driven by a small electric motor. The paper cylinders are very light, perfectly portable, and may be transmitted by mai with the same facility as an ordinary letter. The cylinde

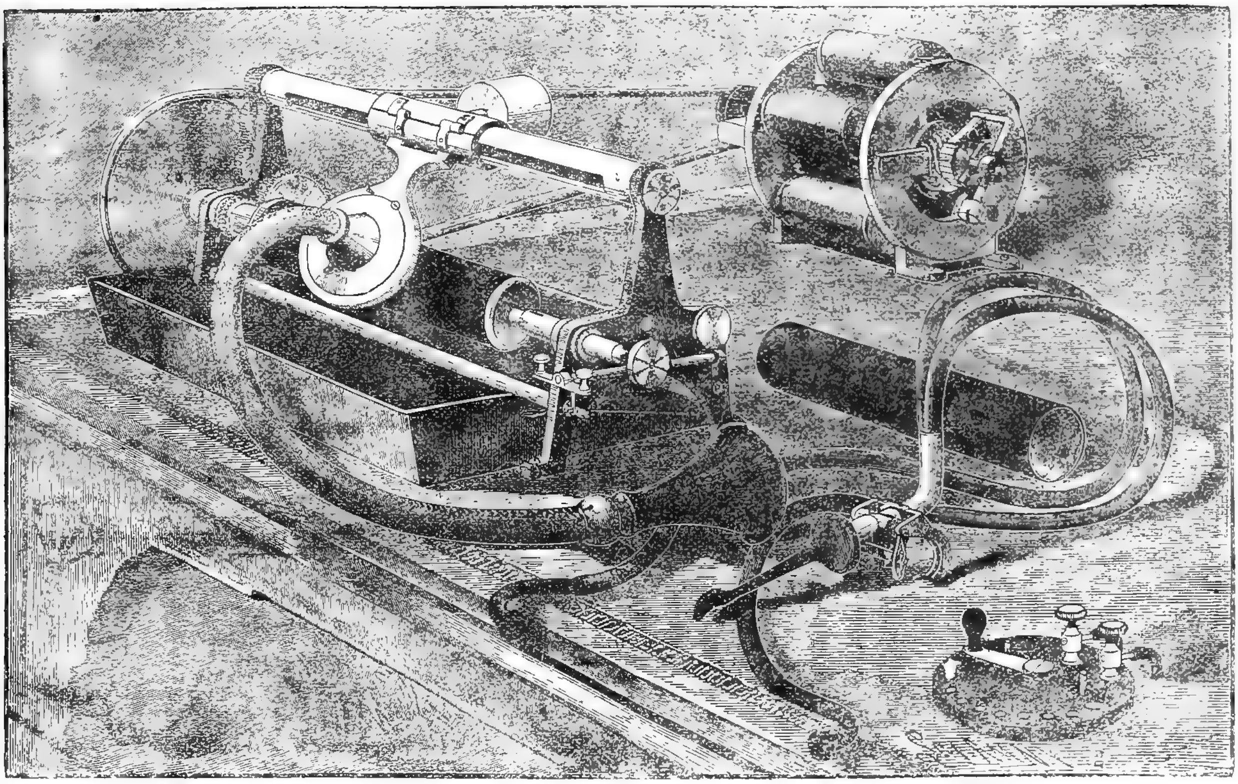


FIG. 1.—TAINTER'S GRAPHOPHONE.

a peculiar way to cause it to maintain its cylindrical form, the outer surface of the paper being coated with a specially prepared wax. Below the cylinder is arranged a pan for receiving the fine shreds of wax cut by the stylus from the cylinder in the operation of recording the message. The groove constituting the record is microscopic in size, it being only three thousandths of an inch wide and about two thousandths deep. One hundred and sixty grooves to the inch are cut on the cylinder. The saddle which holds the diaphragm cell is formed of two parts hinged together to facilitate its removal from the support. After the complete record has been made the cylinder is either removed and placed in another machine or it is allowed to remain, and the recording diaphragm is replaced by the small reproducing diaphragm shown in fig. 2. This diaphragm is connected by a thread with a small rounded finger, pivoted in the end of the arm which supports the diaphragm, adapted to engage the groove and indentations made by the stylus of the recording diaphragm. To the reproducing diaphragm cell is attached a flexible tube which is branched and provided at its extremities with ear pieces similar to those of a stethoscope. The ear pieces are placed in the ears. The rotation of the cylinder containing a message causes vibrations to be set up in the reproducing diaphragm which are similar in character to those of the recording diaphragm which produced the impressions upon the

will fit any graphophone without any adjustment of the instrument. The graphophone has been in practical use for some time past, carrying on correspondence between

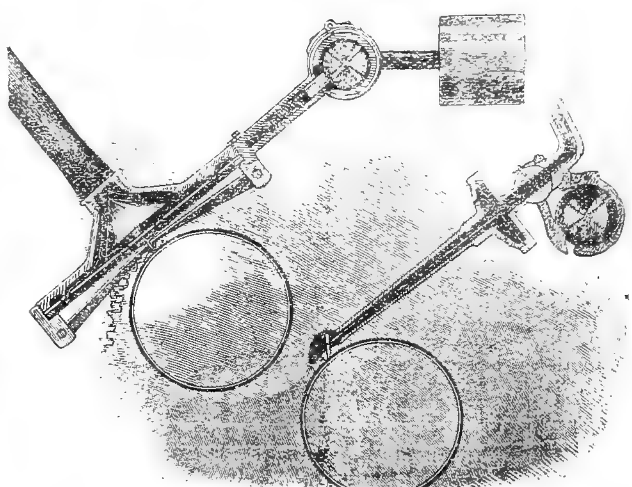


FIG. 2.—RECORDING AND REPRODUCING MECHANISM.

New York and Washington, and in receiving dictation in every-day matters of business the dictations being written out on a type-writer by a copyist who listens to the graphophone. By means of the starting and stopping key, which throws the driving wheel in and out of gear with the recording cylinder, the message can be reproduced sentence by sentence, and reproduction stopped between any two words, or in the middle of a word, if desired. This enables the copyist to take from the graphophone as many words as can be retained in mind, and the machine waits while they are being printed on the type-writer, or written out, as the case may be. Should it be desired to repeat the message, a simple motion of the hand, occupying only a second or two, places the reproducer on any part of the record, and the latter can be repeated a thousand times if desired. The graphophones in general use are provided with treadle motors, which, acting through a very sensitive regulator or governor, gives to the record cylinder a perfectly uniform motion, and as all machines are regulated to run at exactly the same speed, a record made on one machine can be reproduced correctly on any other.

EXTINCT BRITISH BUTTERFLIES,

AND THE CONTINUITY OF EXISTING SPECIES BY MEANS OF MIGRATION CONSIDERED.

THE ordinary observer could not have failed to notice the changes which have taken place in the fauna and flora of the British Isles within, say, the last fifty years.

The plants and animals of any country or district are not absolutely identical for any two successive periods, however brief. Some species are gaining ground, others losing it, while yet others remain practically stationary. These changes are perpetually going on, but very few of them are placed on record.

In the course of a few years the general changes may be inappreciable to the ordinary observer; but locally there are often considerable variations which cannot fail to be detected on close scrutiny. These are links in the great chain of changes whereby the fauna and flora of one geological period are considerably modified, and are gradually converted into the fauna and flora of the succeeding epoch. In the different groups of animals and plants, however, these changes proceed at markedly different rates. Some will change rapidly, while in others the movement is scarcely perceptible.

As a general rule, the change seems to be slowest among the least specialized forms and among those which have been established the longest—the most rapid among the most specialized forms and such as have only recently been introduced.

The *Rhopalocera*, or butterflies of the British Isles, have in particular undergone many great and important changes, even comparatively within the last few years. The lists of only fifty years ago are no longer trustworthy.

We have records of many species occurring in this country which are now extinct. Others, which were very plentiful, are now only occasionally seen. Others, again, which were widely distributed, have become very local, and so reduced in numbers that we may safely venture to predict that within a few years hence they will be entirely extirpated, and the beautiful forms of many which at present adorn our collections will be phantoms of the past.

On the other hand, there are very few species multiplying their numbers or widening their area of distribution to compensate us for such losses. It is the nature and extent of these changes which we are about to consider.

In order, however, to obtain an appreciable estimate of the great changes which have taken place in our *Rhopalocera-fauna* it will be necessary to enter somewhat into details respecting the laws of their distribution.

It is well known that islands are, as a rule, poorer in species than a similar area on adjacent parts of the nearest continent; for instance, the number of species of butterflies indigenous to the British Isles is only sixty, while the number occurring in France is nearly four times that number.

This is brought about by the following means: the isolation consequent on being separated from the continent precludes the possibility of many species passing over from the latter to the island, and thus supplying the place of those forms which may have become extinct, from whatever cause, in the smaller and isolated area.

Now, on a continent, if a certain species become extirpated in any limited district of similar extent the loss would probably be only temporary; for if it belong to any of those species which are ever increasing their area of distribution under favourable conditions, the blank in question would be almost certain to be supplied through migration, and the continuity of the species maintained.

Although the narrow strip of water separating us from the Continent operates as an impassable barrier for many species which would otherwise make their way over here, there are some which possess a powerful flight and are able to overcome the obstacle.

In addition to our isolation, there are other important factors which greatly assist in the reduction of our indigenous butterflies, and are really the primary causes. Of these climate is, perhaps, the principal. Owing to our proximity to the ocean and the gulf-stream, and the excessive humidity consequent thereon, the number of rainy days in the British Isles is greatly in excess of that of any country on the Continent.

Butterflies are entirely dependent on sunshine for their existence; and whereas we get so very little of the requisite in this country, it will be seen that this is tending also to reduce the *Rhopalocera-fauna* of the British Isles out of proportion to the latitude.

The other important factor in the matter is increased drainage and cultivation, thereby causing the extirpation of many indigenous plants which constitute the pabulum of certain butterflies the *larvæ* of which are dependent on them for food.

All these causes operating together are, at the present time, as they have undoubtedly done in the past, bringing about the speedy extinction of our native butterflies. What will be their ultimate fate we can only dimly surmise. Only about a century ago the number of species of butterflies inhabiting this country was probably half as large again as at the present time. Many of the species which have since become extinct have been figured in various Natural Histories, and records of their occurrence have fortunately been preserved for the use of future generations.

The most handsome species of all whose records have been handed down to us is the scarce swallow-tail (*Papilio podalirius*). It is only little more than half a century since the last specimen was seen in this country—namely, at Richmond Park in 1829. Judging from the list of localities it used to frequent, it possessed a wide distribution in this country. The prior recorded dates of its capture are as follows: near Beverley, in Yorkshire, in 1778; near Norwich in 1810; Berkshire, 1826; Shropshire, 1807, and again in 1822; Cambridgeshire, 1818; also in the New Forest, the Isle of Wight, and in Bedfordshire. Though the species is now extinct in the British Isles, it occurs in considerably higher latitudes in adjacent parts of the Continent. Its extirpation over here may probably be attributed to adverse climatic influences, isolation, and increased cultivation combined. It is highly probable that a near relative of the preceding, our only remaining representative of the genus Papilio—namely, *Papilio machaon*—will follow suit not many years from hence; for when *Papilio podalirius* used to occur in this country *Papilio machaon* roamed over the whole of South Britain, being found as far north as Cumberland and Yorkshire, westward as far as Wales, and to the Isle of Wight in the south. There is also a strong probability of its having occurred in the south of Ireland. Now, however, it is entirely restricted to the fenny districts of Cambridgeshire, Huntingdon, and Norfolk, and it is even here much less plentiful than formerly.

It seems very likely that living entomologists will hear

FIG. 5.

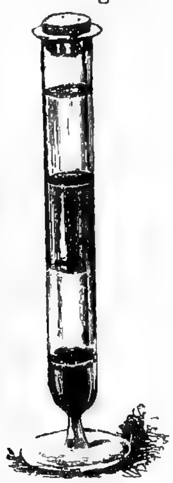


FIG. 6.

of the last swallow-tail being taken in Cambridgeshire and Huntingdon, as both these districts are being rapidly drained and cultivated. Many places where the *Papilio machaon* held its court are now corn-fields. In Norfolk, however, we may hope to have its extirpation retarded. The butterfly in this county has its head-quarters in the neighbourhood of Horning, and the fens hereabouts, owing to tidal influences, are incapable of being drained. Long, we trust, for the sake of entomology, may this be the case.

A more remarkable case than either of the preceding is that of the Black-veined White (*Aporia cratægi*).

This insect only about twenty years ago occurred in great abundance in many localities in the south of England. Dr. Newman speaks of having taken it near Leominster in great numbers at rest on flowers of the ox-eye daisy. Since then, strange to say, it has become entirely extinct in this country, and various have been the speculations respecting its sudden and mysterious disappearance. This, in our opinion, is due principally to a long succession of wet summers which have prevented the insect performing the functions of oviposition.

It is very strange that while this butterfly does not now occur at all in this country, it is to be found in great abundance on the adjacent parts of the Continent, especially in France, where it is said sometimes to cause immense destruction in orchards. In many districts the fate of the fruit crop entirely depends on the abundance or scarcity of *Aporia cratægi*.

The principal districts in our own country which it once frequented were Kent, Surrey, Hampshire, Dorsetshire, and Middlesex in the south; Worcestershire and Herefordshire in the west; and Northamptonshire in the east. In the intermediate localities it was comparatively scarce, It was not found at all in the North of England, Scotland. or Ireland, at least as far as existing records inform us.

(*To be continued.*)

SIMPLE EXPERIMENTS IN PHYSICS.—II.

Cohesion.—A pretty illustration of cohesion. The force which holds the molecules of matter together is shown in fig. 5. In the bottom of a suitable vessel is placed a few drops of olive oil, and into the vessel is carefully poured a mixture of alcohol and water having the same specific gravity as the oil. The oil will be detached from the bottom of the vessel, and will, in consequence of the cohesion of its particles, assume a spherical form. Another method of performing this experiment is to introduce the oil into the centre of the

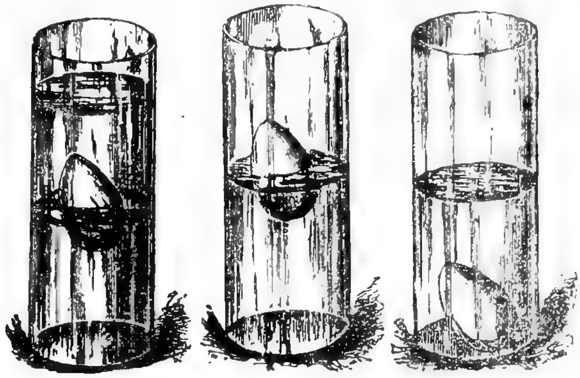


FIG. 7. FIG. 8. FIG. 9.

body of dilute alcohol by means of a pipette. By careful manipulation a large globule of oil may be introduced in this way. Cohesion tends to cause liquids to assume a spheroidal form, but in the case of liquids in large masses, gravity causes them to assume the form of the vessel in which they are contained. The tendency of liquids to assume a spheroidal form is seen in the rain and dewdrops, in liquids dropped from bottles, also in liquids thrown in drops on surfaces which they do not moisten. Water spattered upon a surface covered with lycopodium is an example of this.

Specific Gravity.—The difference in the specific gravity of liquids is illustrated in a striking manner by the "vial of four liquids," shown in fig. 6. A test-tube with a foot makes a convenient receptacle for the liquids. In the bottom of the tube is placed mercury. The second liquid in order is a saturated solution of carbonate of potash. The third is alcohol, coloured with a little aniline red to mark the division of the liquids more clearly. The fourth is kerosene oil. When these liquids are shaken up they mix mechanically, but when the tube is at rest the liquids quickly arrange themselves in their original order. The egg experiment shown in figs. 7, 8, and 9, although without novelty, is interesting on account of its simplicity and effectiveness. Two pint tumblers or similar vessels are necessary for this experiment. Half fill one with water and the other with strong brine. Into the water drop an egg. It goes to the bottom (fig. 7). An egg dropped into the brine floats (fig. 8). By carefully pouring the brine through a long funnel or through a funnel with an attached tube, which will reach to the bottom of the tumbler containing the pure water, the water and the egg will be lifted, and the egg will float in equilibrium at the middle of the tumbler. The first experiment shows that the egg is a little more dense than pure water, the second that brine is more dense than the egg, and the third that the egg can be supported in equilibrium between two liquids of different densities.—*Scientific American.*

THE GLACIAL EPOCH AND THE PRESENT DAY.

ALTHOUGH the former existence of a glacial epoch has passed out of the region of discussion, there are still unsolved questions concerning its origin, its character as single or recurrent, and the possibility of its return. The absolute decision of some of these problems is not to be hoped for to-day or to-morrow. In the meantime every light procurable, be it direct or indirect, is highly welcome. Professor Brückner, in discussing some of these points in *Humboldt*, observes that though the geologist is not in a position to apply any absolute standard of time in measuring the history of the earth he may, by a cautious and critical evaluation of the effects of certain forces, form an estimate of the relative duration of certain geological epochs.

The most recent geological time, the diluvial epoch, is characterised by an enormous development of glaciers. From the Scandinavian Mountains they passed southwards to the foot of the central mountains of Germany and into the heart of European Russia. The Baltic had no existence as a sheet of water, its bed being choked with ice-masses. The glaciers of the Alps filled not merely the mountain valleys, but spread over the sub-alpine territories, both northwards and southwards. A corresponding development of glaciation during the diluvial epoch can be traced in North and South America, in Asia, and Australia. Even within the Tropics our earth did not escape the formation of glaciers, as their traces have been lately recognised in the Sierra de Santa Marta, in South America.

A careful examination of the diluvium leads, in many localities, to the conclusion that the assumption of a single glaciation does not suffice for the explanation of the deposits. There were recognised two glaciations, two icy periods, separated by a milder inter-glacial age. Penck, on examining the region between the Iller and the Inn, was led to the result that there must have occurred a threefold repetition of glaciation, and Professor Brückner, on examining the Salzach region, confirms his inference. Hence we find the following succession of events: First glacial epoch forming glacier deposits, and the oldest "schotter" of the glacier-streams (Brückner applies the term "schotter" to the gravel and other *debris* with which streams originating in glaciers are overloaded, and which they deposit in their beds). First interglacial epoch, erosions by flowing water. Second glacial epoch, repeating the phenomena of the first. Second inter-glacial epoch, with repeated erosion and deposition of the "loess" on the surface of the ground. Third ice-age, with formation of the most recent glacier deposits and stream "schotters." Then follows the post-glacial age, or alluvium, marked by erosion due to flowing water.

From these successive phenomena it is possible to form an approximate conclusion as to the length of the post-glacial age and its proportion to the time elapsed between the third and the second ice-age.

The three "schotter" systems have been piled up by glacier-streams. Upon each period of accumulation there followed a period of erosion which came to an end when the next more recent "schotter" began to be formed. To this alternating accumulation and erosion is due the terrace, or stair-like structure of the three "schotters."

If we compare the destruction which the second "schotter" underwent by erosion before the depositing of the most recent "schotter" with the effects of post-glacial erosion upon the latter, we recognise a noteworthy difference. The erosive work of the post-glacial age (in which we now live) is evidently small in comparison with the erosive work of the second inter-glacial age. Hence it seems that the time which has elapsed since the formation of the most recent "schotter" is shorter than the time which intervened between the formation of the second and of the third, or most recent "schotter." A similar conclusion as to the duration of the first erosion-period may be drawn from the great destruction of the earliest "schotter" effected before the second was deposited. We are in our day probably nearer to the age of formation of the most recent "schotter" than it was to the formation of the intermediate, or than this, again, was to the first. *The post-glacial age is decidedly shorter, so far, than either of the two inter-glacial periods.*

This conclusion drawn from the erosive actions in the times concerned is confirmed by a comparison of the layers of soil, deposited during the post-glacial age and during the inter-glacial age. We see the deposits of the last ice-age covered only by a stratum of brown clay, rarely exceeding a foot in thickness. But to the inter-glacial period belongs the deposition of the strong yellow strata of loess and loess-clay, and though the inter-glacial character of these deposits is still in part contested, yet the affirmative evidence is constantly on the increase. A loess like that formed, according to Professor Brückner's observations, in the second inter-glacial period and completed at its close, is still wanting among the most recent diluvial deposits.

The results thus described are rendered more important by the consideration that they apply to the entire northern sub-alpine country from Switzerland in the west to Enns in the east. Hence the alluvial age is merely the last phase of the diluvial epoch.

That these results throw a certain side-light upon the question of a return of the ice-age can scarcely be denied. As the post-glacial age appears so decidedly shorter than either of the inter-glacial ages, a recurrence of glaciation appears in no wise excluded. But the question can be definitely solved only when the causes of those climatic changes which manifested themselves in the alternation of glacial and inter-glacial epochs shall have been ascertained, and their periodicity accurately determined for the future. No geological evidence speaks against such a recurrence; but if we assume its return, we must expect also a repetition of the "loess" period which would precede the returning ice-age. However, the next attack of glaciation, if it is to be expected at all, belongs to a future which in our way of reckoning must seem infinitely remote.

General Notes.

Deaths from Lightning.—In that part of Europe which comprises Italy, France, Belgium, Rhenish Prussia, and the British Islands about 400 persons are killed each year by lightning. In Belgium alone the storms of June last proved fatal to 11 persons.—*Ciel et Terre.*

Memorial to Charles Darwin.—It is announced that a tablet with an inscription will be shortly inserted in the front wall of the house, No. 11, Lothian Street, Edinburgh, in which Charles Darwin lived in the years 1825-6 whilst studying in the University of that city.

Vulcabeston.—Under this name Mr. R. M. Pratt of Hartford, Connecticut, U.S.A., is introducing a substitute for vulcanised fibre. It can be moulded into any shape, and can be turned and polished. It is said not to soften when exposed to steam, and will not ignite in a gas flame.

Honours Awarded to Pasteur.—M. Pasteur has received no fewer than fifteen orders, of which one only, the Legion of Honour, is French. He is an honorary doctor of all the leading Universities of Europe, and is a member, according to the *Medical Press*, of eighty-three learned societies.

The Fixation of Coal-Tar Colours.—According to a recent discovery, the antimony employed as a mordant can be dissolved, instead of in tartaric acid, in the whey resulting as a waste product in the preparation of cheese. This liquid contains acetic acid, along with a smaller quantity of lactic acid and traces of butyric acid.

The Synthesis of Organic Compounds. — Professor Maumené, in a recent communication to the Paris Chemical Society, maintains that it is possible to effect by means of the electric effluve (silent discharge) the synthesis of all the organic compounds or immediate principles met with in plants or in animals. This can be effected by setting out from principles existing in the atmosphere, such as water, carbonic acid, ammonia, etc.

Predominance of the Polar Atmospheric Current. —This phenomenon, from which we have been suffering during the present season, appears to have been recognised in 1885, and to have persisted to an abnormal extent ever since. Thus in 1887, polar current (that is northerly and easterly winds) is recorded for 202 days, the average being about 120-130. In this year up to August 3rd, the polar current has prevailed for 102 days.

Etching Liquid for Steel.—Take 1 oz. sulphate of copper, ½ oz. alum, and half teaspoonful of salt in a fine powder, and mix with one gill of vinegar and 20 drops of nitric acid. The liquid thus obtained may be used for either cutting deeply into the metal, or for imparting a beautiful frosted appearance to the surface, according to the time it is allowed to act. The parts to be protected from its action should be covered with beeswax or tallow.

The French International Exhibition.—M. E. Sartiaux, chief telegraph engineer to the Northern Railway Company, has been nominated a member of the Organising Committee of the International Congress of Electricians, to be convoked for the Great Exhibition of next year. The other members are—MM. D'Arsonval, G. Berger, Boudet, Bouilhet, Bourdin, Carpentier, A. Cornu, M. Delahaye, H. Fontaine, Gariel, Hillairet, Hospitalier, Joubert, Lemonnier, Lippmann, Mascart, Napoli, de Nerville, Pellat, Picou, Postel-Vinay, Potier, Raymond, Renard, Séligmann-Lui, de la Touanne, Violle, and Vivarez.

Inventors and Lunatics.—Anent the trial of the inventor Raynaud, the *Medical Press* remarks that persons of real or fancied inventive faculties seem peculiarly liable to mental derangement. Our contemporary adds with considerate kindness, that "We would not urge this as a reason for applying restraint to all (!) persons who display inventive tendencies, but lunacy statistics show that the inmates of asylums are drawn largely from their ranks." We think a careful inquiry would show that not a few eminent inventors have been wrongfully treated as lunatics, and have been driven to insanity, not so much by "the constant and unremitting application of the intellectual faculties to one object," as by the treatment which they have undergone.

Manufacture of Wood Oil in Sweden.—This product, along with oil of turpentine, creosote, acetic acid, charcoal, tarry oils, etc., is obtained by the dry distillation of roots, stumps, and other residual parts of trees felled for timber. Wood-oil, as it is produced in Sweden, is not suitable for burning in common lamps, which smoke in consequence of the excess of carbon in the oil. It requires special lamps, which differ, however, little from the ordinary photogen lamps. If wood oil be mixed with photogen in certain proportions, it can be used in ordinary lamps. In its unmixed state it is the cheapest lamp-oil known, costing only 5d. per litre. It is, further, inexplosive, and lasts much longer than the mineral oils. In Sweden there are at present about thirty works, which produce 40,000 litres of this oil.

Production of Wool in the World.—According to *La Nature*, the total yearly crop of wool is about 800 million kilos (1 kilo equals 2⅕ lbs.). Australia and New Zealand contain 75 million sheep, yielding annually 100 million kilos of wool. At the Cape the number of sheep is not ascertained, but the wool exported is 15 million kilos. In La Plata there are at least 100 million sheep, but their produce is only 50 million kilos. The United States contain 50 million sheep, but they do not produce wool enough for home consumption. Europe possesses 200 millions of sheep, which yield 200 million kilos. Here Russia takes the first rank as a wool-producer, followed by Britain, Germany, France, Austria, Italy, and Spain. Forty years ago France had 35 million sheep, but the number has since fallen to 22 millions. India, Central Asia, and China yield 150 million kilos.

A Huge Bridge.—A Bill has been introduced into the American Senate, to obtain the authorisation of Congress for the construction of a bridge across the Hudson River, between the City of New York and the State of New Jersey. The bridge is intended for railway traffic and other purposes. According to the designer, Mr. Gustave Lindelthal, the middle span would be at least 140 ft. above high-water level, and 2,850 ft. in length, and the end spans 1,500 ft. No piers or other obstructions to navigation, either temporary or permanent, would be placed or built between the pier lines. The bridge will be constructed according to regulations for the safety of navigation to be fixed by the Secretary of War, and if the Bill be passed would have to be completed within ten years after the approval of the plans for the bridge had been obtained from the Secretary.

H. Debray.—We regret having to put on record the unexpected death of the distinguished chemist, H. Debray, formerly the pupil and assistant, and subsequently the successor of the illustrious Sainte-Claire Deville. Debray died on the 19th ult. H. Debray was 60 years of age. He was a member of the Institute, an officer of the Legion of Honour, a Professor of the Faculty of Sciences, *Maitre de Conferences* at the Higher Normal School, a Vice-President of the Society for the Encouragement of National Industry, a Member of the Higher Council of Public Instruction, and of the Consultation Committee of Arts and Manufactures.

Exceptional Longevity.—*La Nature* gives the portraits and brief biographical sketches of two natives of France who lived in the last century. Of the former—Jean Causeur, of Ploumogue, a village of lower Bretagne—there exists a portrait painted in 1771 by Charles Caffieri, authorized royal sculptor for the Navy, at Brest, and engraved by Ch. Leverque in 1772. An accompanying inscription states that he was then 130 years of age. There is no confirmatory evidence. The second case is that of M. J. N. de Quersonnières, who was born on February 28th, 1728, at Valenciennes, where his father was royal councillor. He became commissary-general for military requisites in 1789, but fell into disgrace under the Empire and took refuge in London. At 117 years (*i.e.*, A.D. 1845) his portrait was taken and lithographed. His biographer states that at that age his sight and hearing retained "a surprising delicacy of perception." He was still living in 1846, but nothing is said concerning the date of his death.

A Remarkable Hailstorm.—Writing from Lake of Menteith, a correspondent of the *Scotsman* says:—During yesterday forenoon (July 26th) the atmosphere was dull and very sultry, thunder rattling in the distance. Between three and four o'clock in the afternoon, standing with an acquaintance in front of the house discussing your previous day's leader, all at once we were surprised with a most peculiar hissing sound in the direction of the lake, about half a mile distant, bringing out all those living around in real consternation, some suggesting an earthquake. Everything wore a most weird aspect. The sound resembled a great rush of water, and lasted for about ten minutes. A few hours after, taking a walk round the end of the lake, we were surprised to find the woods covered with hailstones, lying in some parts to the depth of 4 ins. My wife carried back with her a sheet 6 ins. by 6 ins. by $3\frac{1}{2}$ ins. thick. Half a mile distant we had nothing but a few large raindrops. Those who have been resident here for the last twenty years say they never heard or saw anything like it. Mr. Walker, of the Lake of Menteith Hotel, informs me that while the shower lasted the lake seemed to be just like a pot of water boiling—not, he thought, affected by the shower, but some underground current. The foliage of the trees has suffered much, the leaves being battered and lying like as if from a shower. A farmer in the vicinity has a field of potatoes laid flat. I don't think the radius of the occurrence was beyond half a mile.

The Tower Bridge.—The following technical description (taken from the *City Press*) of the new bridge, which is rising east of the City under the direction of the Corporation, and comparison with London Bridge, will interest, we believe, a considerable portion of our readers:—Total length of bridge, 940 ft.; total length of bridge and approaches, 2,640 ft.; opening span, width, 200 ft.; opening span, headway, when opened, 135 ft.; opening span, headway, when shut, 29 ft. 6 in.; side spans, width, 270 ft.; side spans, headway, from 20 ft. to 27 ft.; width between parapets, opening span 50 ft.; width between parapets, side spans and approaches, 60 ft.; steepest gradient of approaches, 1 in 40 (steepest gradient of approaches of London Bridge, 1 in 7); depth of foundations, 60 ft. below Trinity high-water mark, 27 ft. below bed of river; sectional area of waterway, 20,040 square feet (London Bridge, 19,300 square feet); depth of water in opening span at high water, 33 ft. 6 in.; depth of water in opening span at low water, 13 ft. 6 in. Estimated quantities of materials in the bridge and approaches:—Bricks, 31,000,000; concrete, 70,500 cubic yards; cement, 19,500 tons; granite and other stone, 235,000 cubic feet; iron and steel, 10,500 tons. Machinery, etc.:—Two steam pumping engines for hydraulic machinery, each 360 horse power, eight large hydraulic engines and six accumulators, four hydraulic lifts in towers for passengers; size of each leaf of opening span, 50 ft. wide by 100 ft. long; weight of each leaf of opening span, including roadway and counterbalance weights, 700 tons; estimated cost, £750,000. The engineer is Mr. J. Wolfe Barry; the contractors are—for foundations, Mr. J. Jackson; for machinery, Sir W. Armstrong, Mitchell and Company (Limited).

The Public Health.—According to the weekly return of the Registrar-General, the deaths registered last week in 28 great towns of England and Wales corresponded to an annual rate of 15·8 per 1,000 of their aggregate population, which is estimated at 9,398,273 persons in the middle of this year. The highest annual death-rates, measured by last week's mortality, were:—From measles, 1·0 in Leeds, 1·1 in Leicester, and 1·3 in Halifax; from scarlet fever, 1·0 in Birkenhead, 1·4 in Bolton, and 1·8 in Blackburn; from whooping-cough, 1·4 in Manchester, and 2·0 in Halifax; from "fever," 0·9 in Salford, and 1·3 in Newcastle-upon-Tyne; and from diarrhœa, 1·3 in Wolverhampton, and 1·5 in Liverpool, in Oldham, and in Sheffield. The 35 deaths from diphtheria in these 28 towns included 21 in London, four in Liverpool, four in Manchester, and two in Sunderland. Small-pox caused three deaths in Preston, but not one in any of the 27 other great towns. In London 2,353 births and 1,308 deaths were registered. The annual death-rate per 1,000 from all causes, which had been 15·7 and 15·8 in the two preceding weeks, further rose last week to 15·9. Different forms of violence caused 63 deaths; 49 were the result of negligence or accident, among which were 25 from fractures and contusions, 11 from drowning, and 6 of infants under one year of age from suffocation. In Greater London 3,062 births and 1,570 deaths were registered, corresponding to annual rates of 28·9 and 14·8 per 1,000 of the estimated population. In the Outer Ring 11 deaths from whooping-cough and 7 from diarrhœa were registered. Whooping-cough caused 3 deaths in Tottenham, diarrhœa 3 in West Ham, and diphtheria 2 in Walthamstow sub-districts.

SUN-DIALS, AND HOW TO MAKE THEM.—I.

A CONSIDERABLE number of books were written during the last century on the art of "dialling," or "dialing," as it was then spelt; but if that word had been used as the title to this paper, it is probable that not one reader in a dozen would have guessed its meaning without a glance at the columns below.

"What an antique air," says Elia in his essay on "The Old Benchers of the Inner Temple," "had the now almost effaced sun-dials, with their moral inscriptions, seeming coevals with that great Time which they measured, and to take their revelations of its flight immediately from heaven, holding correspondence with the fountain of light! What a dead thing is a clock, with its ponderous embowelments of lead and brass, its pert or solemn dulness of communication, compared with the simple altar-like structure, and silent heart-language of the old dial! It stood like a garden god of Christian gardens. Why is it almost everywhere vanished?"

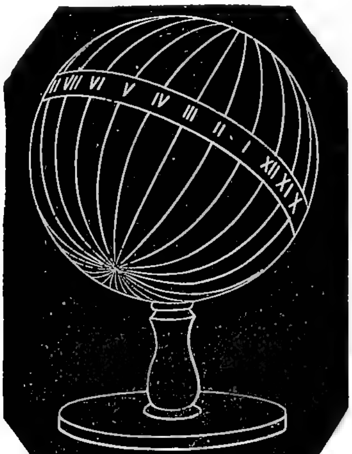


FIG. 1

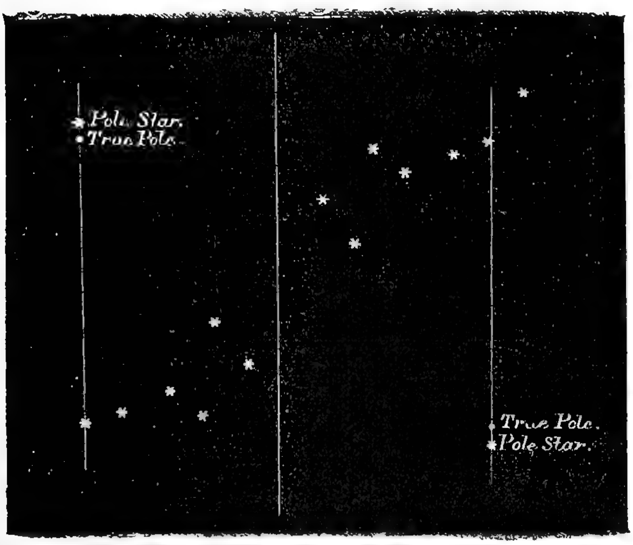


FIG. 2. FIG. 3.

Not only have most of the old dials vanished, but very few new ones are being made. Where a century ago every skilled mason was expected to know something of the art, for a regular art it was, we should now have considerable difficulty in finding anyone but a mathematician who could design the simplest sun-dial. The art was surrounded with no little mystery, and often with a good deal of needlessly involved calculation. The treatises on dialling went, as a rule, into the geometry of the subject, and when this included the consideration of general cases, recourse was had to spherical trigonometry, and the refinements of the art need a certain knowledge of astronomy.

A sun-dial, as a rule, is only adapted for use in the latitude for which it is constructed, and for this reason they cannot be made by the thousand, and the only form in which such a timekeeper can be obtained is that of a small, complicated, and rather expensive "universal" dial at the shop of an optician. Anyone who desires to have a dial painted on the wall of his house, or on the tower or porch of a church, would have a considerable difficulty in finding a workman who could do it.

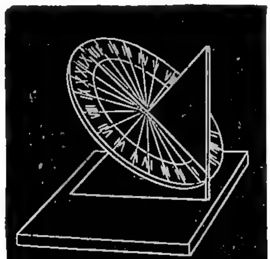


FIG. 4

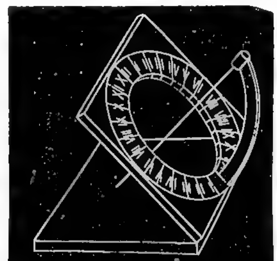


FIG. 5

The following instructions, it is hoped, will render the art of sun-dial making both intelligible and interesting; and a carefully made instrument, which will show the correct time to within two or three minutes, might be both a useful and beautiful object in the humblest garden.

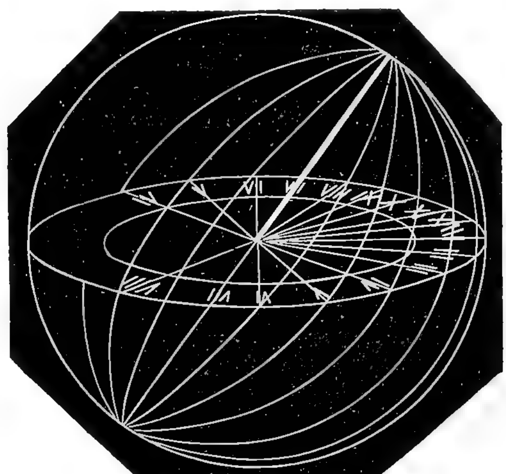


FIG 6

Two motions of the earth have to be considered. First, the perfectly regular revolution of the globe on its axis once in 24 hours. A circle being divided into 360 degrees, the earth moves through 90 degrees or a right angle in 6 hours, and through half a right angle in 3 hours, the motion being uniformly at the rate of 15 degrees an hour. The second motion is that of the earth round the sun. The poles are not at right angles to the path, and, as was explained on p. 373, vol. i., the earth alternately gains and loses part of a revolution, because it does not progress at a uniform speed in its orbit. For this reason the simple sun-dial does not indicate the true time except at the middle of April and June, and at the beginning of September and November. The variation from the true time is given in many almanacks as "sun before," or "sun after the clock." This varies a trifle from year to year, the second year after leap year may be taken as the average. A table of this variation will be given further on in this article.

To an observer on the moon, the earth would form a magnificent timekeeper, hours being marked by the passage of different countries near the Equator into or out of the shadow. Such a dial may be made by setting up a globe so that its axis is parallel to the axis of the earth, as in fig. 1. The north pole of the globe must therefore point to the north pole of the heavens. The Equator being divided into 24 equal parts, the time will be shown by the boundary between the light and the shadow. This line is, however, not well defined, and this renders the method almost useless as a means of determining the time to within a quarter to half an hour, but it is interesting as being the simplest form, as well as that on which all others are based, and in which all others may be said to be contained. Such a globe is sometimes placed on the top of an elaborate dial, and the countries may be represented on it in such a manner that it may be seen at a glance on what part of the globe the sun is shining, and where sunrise and sunset are taking place. The imaginary plane passing perpendicularly through such a globe dial, through its poles, would, if extended, pass also through the poles of the earth. This plane is the meridian of the place, and the line where it cuts the surface of the globe is a line of longitude forming the "great circle" of the place. In setting up any dial it is necessary to find the meridian line. For most purposes this may be done with a good compass, allowance being made for the magnetic variation or declination of the needle from the true north. This is about 17 degrees to the west at Harwich, 17½ at London, 18 at Reading and Peterborough and at places in a line with these towns, 19 at Torquay and Leeds, and 20 at Land's End and Berwick. By drawing these lines on a map, the declination for other places can be found with sufficient accuracy. A large sun-dial can be read to about one minute of time, although one might expect that the edge of the shadow would be too blurred, for the diameter of the sun being about half a degree (see p. 184, first series), and one degree corresponding to four minutes of time, the edge of the shadow is blurred to the extent of about half a degree, or two minutes of time; it is, however, easy to guess the middle of the indistinct part. A fine dial in the gardens of Hampton Court is divided into minutes, and may be read to this degree of accuracy without difficulty. This dial is provided with a table of corrections for "sun before" and "sun after clock" calculated to minutes and seconds, and the same information is given in the form of an interesting diagram in the centre of the dial.

The true north can be found by arranging two fine plumb lines in line with the North Star when the constellation of the Great Bear is in either of the positions shown in fig. 2 or in fig. 3. The middle star of the tail being in a line with the Pole Star and the true Pole. The stars will be as in fig. 2 on the 10th of October at midnight, 10th of November at 10 p.m., 10th of December at 8 p.m., 10th January at 6 p.m., and as in fig. 3 on April 10th at midnight, May 12th at 10 p.m., June 10th at 8 p.m., being 3 min. 56 secs. earlier every day. The Pole Star is about 1 degree 18 seconds distant from the true pole.

The first step towards a practical sun-dial timekeeper is the equatorial or equinoctial dial. This may be supposed to be a thin slice out of a globe dial, the upper and and lower hemispheres being removed, and the axis represented by a thin wire, pointing as before to the North Pole. The circumference of this circle is divided into 24 parts of 15 degrees each, and these may be divided into quarter hours, or into intervals of five minutes, or even minutes, if there be room. As a dial of this kind is very useful in the construction of wall-dials in positions which do not face exactly south, it may be well to remind the reader that it is very easy to divide a circle in twenty-four parts. Draw any circle, and with the same opening of the compasses step round the circumference, thus dividing it into six parts, halve these parts, and then halve again, and these will be the divisions required. The hours may be marked all round so that either side may be used. The XII. line must be set exactly north and south, or in a line with the meridian. The plane of the circle must be set so that it is parallel to the equator of the earth. This is, of course, the case when the axis points to the pole. The angle which the axis makes with the horizon depends on the latitude of the place where the dial is to be used. At the North Pole the dial would be horizontal, and at the Equator it would stand on edge, the axis being horizontal. In either case the VI. line is horizontal, and points east and west.

The latitude of the place where the dial is to be used must be found on a map, and the plane of the dial must be set at this angle of the horizon. The latitude of London is 51½ degs. The angle may be found by a protractor, or by the use of a table of signs or tangents. The angle should be marked on a card, from which a wedge can be cut, and used for adjusting the inclination of the dial with the horizon. Such a dial may be made from a sheet of brass or tin, or even of card, for occasional or indoor use. The axis may be represented by the edge of a piece of metal, as shown in fig. 4. There are in this case really two axes, and two half dials, separated by the thickness of the piece of metal, which is called a style or gnomon. Sometimes a thin wire or thread is used, a support being fixed to hold it, as in fig. 5. In this case, the centre of the shadow must be taken as indicating the time. Many dials are provided with a tolerably thick gnomon, but are divided as though a single axis, such as a fine wire, were used to cast the shadow; their indications will evidently be inaccurate, especially near noon.

The equinoctial dial must be divided on both sides, for the sun will sometimes shine on the upper, and sometimes on the lower side. On and near the days of the spring and autumn equinox, hardly any shadow will be thrown, for the sun will be practically in the same plane as the dial. There are many interesting specimens of equinoctial and other dials among the exhibits of mediæval metal work at the British Museum. These are well worth a visit to any one who is interested in the subject.

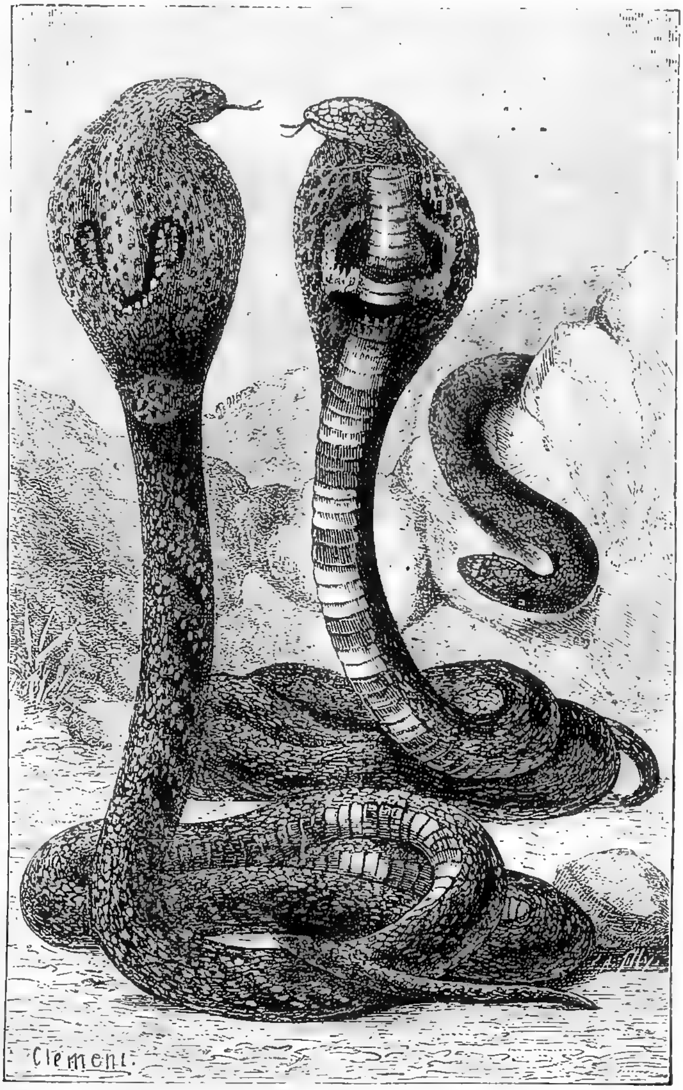
(*To be continued.*)

Natural History.

THE COBRA (NAJA TRIPUDIANS).

Of all the death-snakes the cobra is, beyond all doubt, the most important and the most fatal. Whilst authentic cases of recovery from the bite of the rattle-snake, the jacarandi of Brazil, the lance-head of Martinique, and the tiger-snake of Australia are on record, applied instantly after the introduction of the poison, has proved useless. Perhaps the nearest approach to success has been the maintenance of artificial respiration and the application of electric currents.

The native physicians of India profess to rely upon certain traditional remedies, but when an animal has been really bitten, or, what is always more conclusive, has been inoculated with a minute quantity of the venom, the case has always ended in death.



Cobras.

there is no known instance of the venom of the cobra, if once introduced into the system, proving other than deadly. The only certain exceptions to this sad rule are when immediate amputation of the part bitten has been effected.

We sometimes hear or read of alleged cures, but none of these cases will bear close examination, there being no certain evidence that the bite was really inflicted by a cobra. Numerous experiments have been made upon various animals, in order to test some alleged or supposed remedy, but in all cases the treatment resorted to, though

If the poison, before it is introduced into the blood, be mixed with the chloride of platinum, it is in some unknown manner decomposed, or at least rendered inert. But if the poison is once instilled into the body, it is useless to send the chloride of platinum after it. The supposed remedy cannot overtake the venom, and merely spends its action upon the blood. So far as it is yet known, no animal enjoys any immunity from this poison; all, if bitten, succumb. Nay, if the venom is merely applied to the eye-ball, the lips, or to any mucous membrane, the result is the same. It was formerly supposed that the mungus (*Herpestes griseus*) was proof against all serpent bites. This little animal is indeed wonderfully successful in destroying the cobra and other Indian death-snakes, but it effects its task simply by its wonderful agility, which enables it to tear open the throat of the snake before the latter can plant a bite. But if a mungus is inoculated with cobra-venom it perishes, just as would a rat, a dog, or, for the matter of that, a man.

The body of this formidable serpent is rounded, slightly thickened about the middle, and the head has the same width as the neck, so that it presents, when at rest, very much the same appearance as the ordinary non-poisonous snakes. When excited it erects the anterior part of its body and expands the skin of its neck, so as to form a kind of hood extending behind the neck. The gape of the mouth is wide, which gives greater facility for biting. On each side of the upper jaw there is a poison-fang. The fangs are not, as in some serpents, capable of erection and depression, but are immovable.

In colour this formidable reptile varies. Most commonly its general colour is of a uniform deep brown, sometimes verging on black, and often intersected on the side by white transverse stripes. When the neck is distended, there appear behind two white spots with black centres, connected by a white arch bordered with black, and presenting a rough resemblance to a pair of spectacles.

In length the cobra varies from 2 feet to 2½ yards. It inhabits India, Ceylon, the Eastern peninsula from Burma to Siam and Tonkin, and even the more southern parts of China. It is common in the Western portion of the Malay Archipelago, but it has never yet been found in Celebes, the Moluccas, New Guinea, or Australia. In Persia, Arabia, Egypt, and in the north, east, and south of Africa it is replaced by a kindred species, *Naja Haje*, very similar in its habits and in the intensity of its venom, but for the most part smaller. In India the true cobra is exceedingly numerous; it haunts drains, wells, water-holes, old tree-trunks, ruined walls, stone heaps, etc. Far from shunning man, it frequents by preference towns and villages, and enters houses. It pursues fishes in the streams, climbs palm-trees to capture birds, and hunts for mice, rats, lizards, frogs, etc., in gardens and courtyards. These habits, in addition to its nocturnal character, make it much more dangerous than it would be if it confined itself to the woods and the marshes. It is said that in British India alone more than 10,000 persons perish yearly from its bite, so that its destruction, if possible, becomes an imperial interest.

It seizes and swallows its prey at once, neither strangling its victims by constriction, like the pythons, nor biting and then waiting until the venom has taken effect.

The nature of this serpent's prey raises a very difficult question. Why or how should the cobra elaborate a poison so much more powerful than it apparently needs? The intensity seems a luxury. To a creature feeding on rats and mice, what use is it to be able to kill a dog, a swine, a man, perhaps a tiger or a panther? For defence it can scarcely be, since the wounded animal, though sure to succumb in a couple of hours, has ample time to take its revenge.

The pugnacity of the cobra, and its confidence in its own resources are boundless. It needs very little provocation to act on the offensive. Had Waterton studied the cobra and, indeed, certain other Indian and African serpents, he could not have said that they flee from man and never pursue a retreating enemy. It is on record that a dog, seeing two cobras in a meadow, committed the indiscretion of barking at them. The snakes, instantly uncoiling, gave chase. The dog leaped into a river, but the cobras, overtaking him in the water, bit him so viciously that he died in less than an hour.

It is curious that the snake-charmers of the Far East are fond of exhibiting tamed cobras in their performances. It is sometimes said that the poison-fangs are carefully broken out of the cobra's jaw. But we are inclined to suspect that these serpents are hypnotised—a state to which reptiles have been proved to be susceptible. They are even, it is reported, rendered stiff and inflexible as rods—in other words, thrown into a state of catalepsy—and in that state are handled and flourished about by the jugglers. Here, however, further investigation is wanted.

NOTES ON THE TIGER.

Mr. Inverarity communicated, a short time ago, to the Bombay Natural History Society, a paper on this subject, from which we make some extracts. The size of the animal is apparently often exaggerated. The author thinks that the majority of tigers are under 9½ feet. The measurements taken by sportsmen are, however, invariably deceptive, as they persist in running the tape from the tip of the nose to the end of the tail, instead of to the root. As the tail bears no fixed proportion to the size of the animal, the result is worthless. Tigers are supposed to breed once only in three years, which Mr. Inverarity coolly pronounces "unsatisfactory intelligence for the sportsman."

These animals, it appears, may reach the age of twenty years. The evidence on which this statement rests shows the mischief resulting from the neglect of sportsmen to use poisoned bullets.

In weight the tiger ranges from 350 to 700 lbs.

The author denies that tigers in killing dislocate the neck or sever any important blood-vessel. Large and powerful animals like the bull buffalo and bull bison (a bison in India!!) are attacked from behind. Occasionally the tiger will feed upon the dead bodies of its own species. Mr. Inverarity has never met with any instance of the "sledge-hammer stroke" of the fore-paw of a tiger. Lastly, we notice that this beast is not absolutely unable to climb trees, as it is commonly believed.

Abnormal Habits of Animals.—Correspondents of the *Field* declare that in Britain rabbits have been occasionally known to climb trees, and two cases are given of dogs having performed the same unlikely feat. Hares are also said sometimes to burrow, and rabbits to swim.

Sensitiveness of the Eye.—The sensitiveness of the eye for different colours is not identical. Herr H. Ebert (*Cosmos*) finds that it is greatest for green. Then follow red, greenish-blue, yellow and blue. A spectrum very dimly illuminated appears as a uniform grey band.

THE LOCOMOTION OF CATERPILLARS.

In a communication to the Academy of Sciences M. G. Carlet describes the result of his observations on the locomotion of caterpillars. It has been hitherto supposed that when creeping, the two feet of the same pair are never moved together, a notion which the author fully refutes.

It is well known that the body of caterpillars is composed of twelve rings, exclusive of the head. The three first rings support each a pair of pointed legs, which we may call 1, 2, 3; then follow two footless rings, followed by four rings bearing each a pair of broad, wart-like legs, frequently armed with hooks, and known as *pseudo legs* or *false legs*, because they disappear when the insect assumes its adult condition. We may name them 4, 5, 6, 7. Then come two more rings without legs, and lastly the end ring with two membranous feet, the *anal legs*. Thus, except in some exceptional cases to be mentioned hereafter, a caterpillar has sixteen legs.

If we take a common caterpillar, and let it creep on a flat slip of wood, held on a level with the eye, we see that the two feet of each pair are always lifted together.

Suppose a caterpillar at a standstill, with its body stretched out. Its first movement is to detach the anal pair (8), and bring them up to the pair 7 by contracting the two penultimate footless rings which separate them from 7. The pro-legs (4, 5, 6, 7) are then released *from behind forwards*, in the order 7, 6, 5, 4, and are at the same time pushed forward by slackening the two penultimate footless rings, like a spring set loose. This series of progressive movements of the rings arrives, like an undulation, at the two anterior footless rings. These rings are compressed by the release of the two hinder footless rings, and the pair of legs 4 are thus brought close to the pair 3. This pair is then raised, and in quick succession the pairs 2 and 1.

We thus understand why the false legs are so robust in comparison with the others. They might be called mooring feet, since they really support the caterpillar and govern its movement. They also secure the caterpillar in its situation at the moment of its transformation.

We may now understand why the Cossus and certain other wood-gnawing caterpillars have their false legs membranous, or devoid of hooks. This arrangement is in harmony with their manner of life in the tree trunks in which they excavate their galleries, much as do the larvæ of the wood-eating Coleoptera, which have either very short legs or none at all. In compensation, their masticatory apparatus is developed in proportion to its activity—that is, inversely as the locomotive organs. In both cases the same mode of life has brought about similar arrangements in creatures belonging to different groups. The foregoing considerations explain also why, when caterpillars have only three pairs of false legs, the three last pairs remain. If there are only two pairs of false legs we find the two last only, and then the caterpillar, deprived of all intermediate legs, arches its body into a loop, so as to approximate the true legs to the false legs. It then detaches the true legs from their foot-hold, and advances them in order to fix them again. This kind of locomotion places them at some disadvantage in comparison with other caterpillars having sixteen legs. But they have other means of escaping from their enemies. In fact, the caterpillars which feed upon the bark of trees have a grey or greenish colour, which enables them to pass unperceived. They also remain fixed by their hind feet, with the body stiffened, so as to imitate a twig.

[We can by no means admit that the looper or spanner caterpillars (*Geometræ*) are slow in their movements.—Ed. Scientific News.]

THE ZOOLOGY OF THE BATH DISTRICT.—I.

THE immediate neighbourhood of Bath, although very picturesque and beautiful, is a somewhat disappointing locality for the naturalist, consisting, as it does, mainly of well-cultivated lands, with no wilder portions, no undrained marsh or fenlands, no uncultivated moor, or heath, or wood that has remained for centuries unreclaimed and, untouched. The neatly cropped hedgerows, the regularly mown railway banks, and even the mud periodically scraped out of the canal—the order and neatness everywhere observable are all great drawbacks to the collector of zoological treasures.

The most promising features are the Avon and the Kennet and Avon Canal above Bath, and the valley of the Avon below, towards Bristol, also a few small patches here and there, as on Lansdown, Claverton Down, etc.; better still, but rather out of the district lie the turf moors of Shapwick and Glastonbury. These are happy hunting-grounds for the entomologist or student of other invertebrate branches, mollusca, etc., and will yield rich harvests to those who will work them carefully, and are also the spots most likely to be visited by the migratory birds and other accidental visitors.

To begin with the higher branch—namely, mammalia—of the ordinary feræ, the badger (*Meles taxus*) and the otter (*Lutra vulgaris*) seem commoner than farther east. The stoat, or ermine (*Mustela erminea*), and the weasel (*Mustela vulgaris*) are very abundant; curiously enough, some of the country folk invariably reverse the names of these two species, calling the *smaller* one the stoat, and the *larger* one the weasel.

The polecat (*Mustela putorius*) is getting almost extinct in the district; 1879-80 is the last reliable record of its occurrence; thirty years ago it was quite common, and has been seen in very severe weather, hunting in packs of ten or more individuals.

Of the bats seven species occur. The noctule (*Vespertilio noctula*) is somewhat rare. The pipistrelle (*Vespertilio pipistrellus*) is also rare, although the commonest bat in many parts of England. The whiskered bat (*Vespertilio mystacinus*), "said to be very rare in England," is quite common round Bath in the roofs of old houses. The reddish-grey bat (*Vespertilio nattereri*) also occurs, although rare; two specimens may be seen in the "Duncan Local Museum," at the Bath Literary Institution. The eared bat (*Plecotus auritus*) is fairly common. The great horse-shoe bat (*Rhinolophus ferrum-equinum*) and the lesser horse-shoe bat (*R. hipposideros*) both occur in stone-quarries; the latter is much the rarer of the two.

Mr. Charles Terry, F.R.C.S., in "Wright's Historical Guide to Bath" (1864), gives a list of the fauna within a radius of six miles of Bath. He therein mentions six species of bats, one of which (*Vespertilio emarginatus*), the notch-eared bat, is most likely a mistake; he makes no mention of *V. nattereri*, or *V. mystacinus*.

Of the Insectivora, the mole (*Talpa vulgaris*), the hedgehog (*Erinaceus Europæus*), and the common shrew (*Sorex tetragonurus*) are abundant. The beautiful little water-shrew (*Sorex fodiens*) also occurs, but is rather scarce; this species is easily distinguished from the former by its rather larger size and by the distinct line of demarcation between the dark upper portion and the light (almost white) lower portion. The variety which has been described as *Sorex remifer* is mentioned by Mr. Terry in his list.

Of the Rodentia, the dormouse (*Myoxus avellanarius*) is fairly common, but local, mostly on the margins of woods. The water-vole or water-rat (*Arvicola amphibius*), is somewhat scarce in the banks of the Avon, but gets more abundant lower down, towards Keynsham and Bristol, where the black variety occurs. The short-tailed field-mouse, or field-vole (*Arvicola arvalis*), is fairly common. The bank-vole (*Arvicola pratensis*), although considered a rare and local species, is also fairly common, especially so nearer Bristol, where it abounds in Leigh Woods.

The black rat (*Mus rattus*) is very rare, much more so than in Bristol, where in some warehouses they are plentiful, and are said by the rat-catchers to be fiercer than their bigger and too-abundant rivals, the brown, or Norway rat (*Mus decumanus*). The long-tailed field-mouse (*Mus sylvaticus*) is very abundant, and is the most destructive species in the neighbourhood. The pretty little harvest-mouse (*Mus messorius*) also occurs, but is rare and difficult to obtain.

Of birds, the district can show a good list, at least of inland species. Mr. Charles Terry gives a list of 159 species, of which, however, twenty are only single instances or purely accidental occurrences. Among the Raptores the peregrine falcon (*Falco peregrinus*) is often seen, sometimes hovering over the town on the look out for some unfortunate pigeon; but it is very rarely shot, owing to its extreme wariness. The buzzard (*Buteo vulgaris*) is getting scarcer every year. The honey-buzzard (*Pernis apivorus*), the little owl (*Athene noctua*), and the scops owl (*Scops giu*), although on record, are hardly likely to occur again. The instances on which the record is founded are very doubtful, and date nearly fifty years back

The great grey shrike (*Lanius major*) has occurred several times of late years, although it generally keeps farther west and nearer the coast, as at Clevedon, Weston-super-Mare, etc. The pied fly-catcher (*Muscicapa atricapilla*) will be found to occur occasionally, and even stay to breed, if undisturbed. The dipper (*Cinclus aquaticus*), of which a beautiful nest is in the "Duncan Local Museum," from Wellington, is occasionally seen; its congener, the ring-ouzel (*Turdus torquatus*) is sometimes seen also, though very rarely, preferring the wilder parts of the county, as, for instance, at Dulverton, where it regularly breeds. Our beautiful summer visitor the whinchat (*Pratincola rubetra*), is commoner than the stonechat (*Pratincola rubicola*), though the contrary is the case farther east; it often nests on the G.W.R. embankments. Of the warblers, the sedge-warbler (*Acrocephalus phragmitis*) is very common by the banks of the Avon; and the reed-warbler (*Acrocephalus streperus*) is not uncommon, though much more local than the former; it seems to prefer some quiet, undisturbed pond, overgrown with rushes. Six or seven pairs have been found nesting in such a locality. That rarity the marsh-warbler (*Acrocephalus palustris*) is also very likely to reward a careful study of the local warblers; it has nested farther south, near Taunton, and farther north, near Gloucester, and should occur in the many suitable spots near Bath; it is more than likely to have been overlooked, owing to its resemblance to the reed-warbler. The grasshopper-warbler (*Locustella nœvia*) is often heard, but rarely seen. The garden-warbler (*Sylvia hortensis*) is not uncommon, but very local in its distribution.

The cirl-bunting (*Emberiza cirlus*) some seasons can hardly be called rare; it nests in the district. The snow-bunting (*Plectrophanes nivalis*) is also an irregular visitor, *vide* some good specimens in the local museum. That handsome bird the reed or black-headed bunting (*Emberiza schœniclus*) is very common in the Avon meadows. The siskin (*Chrysomitris spinus*) is captured some autumns in considerable numbers. The lesser redpole (*Linota rufescens*) is also a regular visitor in autumn and winter; sometimes a few pairs breed in the district. The hawfinch (*Coccothraustes vulgaris*) is also an irregular visitor, a nest from Coombe Down is in the local museum. Of woodpeckers, the greater spotted (*Dendrocopus major*) and the lesser spotted (*Dendrocopus minor*) both occur very locally, and are seen year after year in the same wood. Fifteen or twenty years ago the "lesser" was the commoner of the two; of late years the "greater" has occurred most frequently. The rare visitor the hoopoe (*Upupa epops*) has occurred several times, as also the bee-eater (*Merops apiaster*), one at Widcombe, 1850, and three near Bristol, 1870, shot whilst hawking round bee-hives.

Of the doves the ring-dove, or wood-pigeon (*Columba palumbus*) is very abundant. The turtle-dove (*Turtur communis*) is not uncommon in summer; the stock-dove (*Columba œnas*) is rare. That interesting visitor the sand-grouse (*Syrrhaptes paradoxus*), whose incursion this year has caused so much comment, has come near the district, a fine male having been shot in July on Ken Moor.

The sandpipers are poorly represented, with the one exception of the common sandpiper (*Tringoides hypoleucos*), which is numerous in the Avon meadows; the other species only occur as rare stragglers, keeping, as a rule, farther west, nearer the coast. The grey phalarope (*Phalaropus fulicarius*) has been shot on several occasions; five were obtained in 1840, and several others as rare visitors since.

Of the Ardeidæ, the common heron (*Ardea cinerea*) is fairly common, and the bittern (*Botaurus stellaris*), though scarce, and getting much more so of late years, has occurred several times at Bathampton, Kelston, and Lansdown. The spotted crake (*Porzana maruetta*) occurs as a regular visitor, though rarely obtained, owing to its skulking habits. The coot (*Fulica atra*) is often seen on the Avon in the winter, and breeds in other parts of the county. Of the ducks, the peat-moors about Shapwick are regularly visited by some rarities, as, for instance, the beautiful shoveller duck (*Spatula clypeata*). Of the grebes, the little grebe (*Tachybaptes fluviatilis*) is a resident, and the Sclavonian grebe (*Podiceps auritus*) and the great crested grebe (*Podiceps cristatus*) occur now and then as visitors.

Only the commoner gulls come up the Avon, as, for instance, the common gull (*Larus canus*), the black-headed (*L. ridibundus*), and the kittiwake (*L. tridactylus*), this latter somewhat scarcer, and an occasional herring-gull (*L. argentatus*). The common and Arctic terns (*Sterna fluviatilis and S. macroura*) have been seen, though very rarely, over the canal, and once or twice a lesser tern (*Sterna minuta*).

The fork-tailed petrel (*Procellaria leucorrhoa*) and the storm-petrel (*Procellaria pelagica*) have both been picked up in the neigbourhood, evidently driven out of their way by gales.

(To be continued.)

THE NATURALIST AT THE SEA-SIDE.

IV.—THE MARINE AQUARIUM.

BY this name very different things may be understood. There are the homes of pet anemones, built carefully and well tended, and there are the rough adaptations of household vessels, extemporized by the working biologist. These latter may be soon dismissed, though they are for real study far more important than the other and relatively permanent sort of aquarium. Nothing is handier for larvæ, and crustacea, and zoophytes, fresh caught and awaiting examination, than a row of tea-cups. The opaque sides and white inside are exactly what is wanted. A can of sea-water carried up from the beach once or twice a week will suffice to change the effete water, and daily aeration with a glass syringe is the only other necessary means of health. Bits of sea-weed are generally desirable, and certain creatures absolutely require mud or sand.

Though it is true that such hasty provision as we have described is perfectly suited to the collector who has the sea at his doors, the inland naturalist must have his more difficult requirements considered. Everything is now changed by the circumstance that sea-water is hard to procure in large and frequent supplies. With good management, one filling may be made to last for years, and attention must be paid to the only way in which this is possible. The tank should be long, and not very deep or broad. If the ends are square, and the length twice or thrice the depth, the proportions will be found good and convenient. Place the tank in a window. In the bottom fit loosely a number of roofing-slates, each a little longer than the width of the floor, which may form a false bottom, sloping away from the light at an angle of about 25°. Paste a strip of opaque paper on the outside of the glass, so as to darken effectively the space beneath the slates. You have now beneath your aquarium a capacious dark chamber in which life is discouraged. The water, of course, communicates freely with that in the upper chamber, and keeps all cool and fresh. Aerate the tank daily with a glass syringe, and fill up with fresh water as requisite. Two glass bulbs, so weighted that one just floats, while the other just sinks in sea-water, may be bought of the dealers, and these are convenient for indicating the exact amount of water to be added. Failing these, a mark on the side of the tank can be made to do. Rock-work is desirable, but care must be taken to avoid cements which contain red lead or caustic lime. After the tank is complete, but not stocked, it is a good plan to fill it first with fresh water for a fortnight, then with sea-water for another fortnight, and lastly with a second, and, let us hope, final quantity of sea-water.

In the old days, before Lloyd had shown what was possible and what was not, the enthusiast used to plant his aquarium with *Fucus or Laminaria*, and then introduce star-fishes, anemones, crabs, and perhaps a fish or two. In a few days the things began to die, and after a fortnight the aquarium was in the condition of a sewage-settling tank. Long experience has shown the impracticability of these ambitious ventures. Without a good deal of attention and special precautions, nothing can be trusted to thrive except anemones and such vegetation as springs up spontaneously in the tank. The slates and the glass sides soon turn green with confervæ, and this helps materially to sweeten the water. Many species of anemone thrive wonderfully in inland tanks, and some of the most beautiful forms can be kept for many years in this way. Don't feed them at all. They require very little, and that little they find for themselves. One common species (*Tealia crassicornis*) does not survive long in confinement. Its base is very tender, and it is generally fatally injured in removing it from its native rocks. The emission of young anemones is a frequent event, but the young brood hardly ever produces a well-grown individual. In our own experience no single case of the successful rearing of a young anemone has occurred.

The anemone-tank, well managed, may be made as gay as a flower-garden. Varied in colour, and form, and texture, some standing up on the bottom, others projecting from their chosen niches in the rockwork, the polyps delight the eye with their waving tentacles, their gem-like spots, and their discs painted like cathedral glass. It gratifies abundantly that delight in curious and beautiful sights which is a great part of the charm of natural history to glance daily at a richly stocked and well-managed anemone-tank. But there is little to be learnt from it. The creatures whose habits and modes of life are better worth daily observation and study can only be kept alive where a large body of water is mechanically circulated or where loving diligence is spent upon their welfare. It is possible, but not easy, to keep very curious and active marine animals, tube-dwellers, or creatures with strange transformations, alive for months in places far from the sea. The secret lies in isolation of each species and continual supervision. Tiny aquaria of the tea-cup or glass-tube pattern are wanted. If there is a large anemone tank at hand for changing the water daily, so much the better. A neat-handed observer, not afraid of trouble, will find many things possible which the ordinary amateur, enthusiastic but not persevering, cannot be recommended to try.

If mechanical circulation with a limited supply of sea-water is urgently required, the following plan can be recommended: Arrange three or any larger number of glass bowls on shelves, so as to secure slight differences of level. Connect the bowls by bent tubes, which may act as siphons. Start the circulation with the top vessel full and the bottom one empty. A gentle stream will then traverse the whole series, and the current can be renewed at pleasure by emptying the bottom vessel into the top one. If the system is on so large a scale that difficulty is met with in raising the surplus water to the top, some simple mechanical contrivance, such as a bucket and pulley, may be employed. If muslin strainers are attached to the ends of the siphons a great variety of animals may be kept distinct, each set being confined to its own tank.

Reviews.

The Midland Naturalist. Vol. XI., Parts January to July, 1888, inclusive.

Among the many important papers in this journal we may particularly notice that on the function of tannin in the vegetable kingdom, by Mr. W. Hillhouse, F.L.S. The author finds no evidence that it ranks as a food-material analogous to starch, glucose, or oil.

Mr. W. Jerome Harrison expounds the aid which may be rendered to geology—as, indeed, to other branches of science—by photography, and complains justly that "nine out of ten people still think of photography as simply a mechanical way of taking portraits."

Mr. Hillhouse contributes three papers on the "Present and Future of Science-Teaching in England." This able writer asks, "What proportion of an average schoolboy's existence is given to physical or biological science, the knowledge of the world which surrounds him, of the laws which govern his existence, and which will govern him in his struggle for the power to live? Is it one-half? No. One-quarter? No. Doubtful even if it is one-eighth in the best of cases, and from that it sinks away to nothing! And yet we pride ourselves upon being a practical people, when it is doubtful whether one more unpractical, more improvident, exists upon the face of this earth." He concludes his last paper with the weighty remark, "The golden rule of our educational method of the future will, I believe, be not to accumulate information, but to cultivate ability; not to cram the brain, but to train and develop the faculties. Knowledge may indeed be power, but intellectual power is more than knowledge."

Mr. Wragge, the Government Meteorologist of Queensland, gives an account of the climate and resources of this important colony. He considers that the underground water-supply, even in the western parts, where the rainfall is scantier than on the coast, is ample.

An article by Mr. J. G. Baker, F.R.S., F.L.S., on "Kew Gardens and the Botanical Statistics of the British Possessions," is exceedingly interesting. The number of plant species inhabiting the British Empire is estimated at 46,000, or very nearly one-half of those found on the entire earth. The late Sir W. Hooker planned, we learn, a series of works classifying and defining the plants of the empire upon one uniform system. The volumes for Australia, New Zealand, Hong Kong, the West Indies, and Mauritius are finished; that for India is far advanced; those for the Cape and the West Coast possessions are about half finished.

It is not generally known that the Princess Augusta, the mother of George III., was the originator of the Botanical Gardens. The Earl of Bute, the unpopular Premier in the early part of the reign of George III., was an enthusiastic botanist, so much so that he spent £10,000 in printing an elaborate botanical work in nine volumes, of which only twelve copies were struck off. One of the chief objects of Kew Gardens is the horticultural and agricultural benefit of the Colonies. The total number of plants there cultivated is nearly 50,000.

"Passages from Popular Lectures," by Mr. F. T. Mott, F.R.G.S., includes an account of the umbelliferous plants. Here we find a passage to which grave exception may be taken. Says Mr. Mott, "The world will never cease to remember with shame and grief the death of Socrates." If we reflect that he turned away the minds of men from the study of physical and biological science, and that he seems to have originated that antithetical distinction between "Nature" and man, which we are now under the guidance of Darwin beginning to reject, we can only consider the Socratic movement as an apostacy. Though his execution was a judicial murder, it was of little moment as compared with that of Lavoisier.

A Handbook for Steam Users. By M. Powis Bale, M.I.M.E., A.M.I.C.E. London: Longmans, Green, and Co.

A useful, practical little book, that would repay perusal by all users of steam-engines, as a knowledge of its contents would enable them to exercise some check on the frequently incompetent men allowed to have charge of boilers. We suppose it would be too much to expect boiler attendants to read this book themselves until it is made compulsory for them to have a certificate of competency before being allowed to take charge of boilers. We agree with the author that there is little doubt that many disastrous explosions have been clearly traced either to the gross ignorance of the attendants or the criminal carelessness of the owners, and without an adequate system of compulsory inspection and certificates of competency we are likely to hear of many more of these "accidents."

Twelfth Annual Report of Her Majesty's Inspectors of Explosives; being their Annual Report for the Year 1887, presented to both Houses of Parliament by Command of Her Majesty. London: Her Majesty's Stationery Office.

Few persons, we imagine, will question the utility of Governmental inspection and regulation in the manufacture of explosives. Without such interference this industry would constitute a grave danger, not merely to the men employed, but to all persons living in the neighbourhood.

The first point we notice in the report before us is a curious inconsistency in the Explosives Act, which has only just been perceived and amended. Picric acid has long been known to be violently explosive under certain conditions and in certain combinations or mixtures. It is, in fact, supposed to be one of the ingredients of the new French explosive, melinite. Hence its manufacture and storage came very naturally within the scope of the Act. But there was a curious and most illogical proviso—*i.e.*, that it was amenable to control only if made for engineering, military, or pyrotechnical purposes! If manufactured, as was at one time largely the case, for use in dyeing or in the preparation of other colours it was exempt.

An accident which occurred on June 22nd, 1887, at the chemical works of Messrs. Roberts, Dale, and Co., of Cornbrook, Manchester, opened the eyes of the authorities to the very plain fact that the properties of a substance in no manner depend on the purpose or intention with which it is made or sold. They have also doubtless learnt that a manufacturer or merchant does not always know to what use his customers intend to put the articles which they buy. Messrs. Roberts and Dale are, we believe, chiefly, if not exclusively, manufacturers of chemicals for dyers and tissue-printers, and in not placing their works under Government inspection they were acting in a perfectly legal manner. The conclusion arrived at in the inquiry was that the accident originated in a fire at or close to the stove in which picric acid was drying. The fire was caused by one of the workmen, named Heyes, smoking. The main explosion was due to the detonation of a quantity of picric acid or of some self-formed picrate. Only one death resulted, but the damage to property was very considerable.

In consequence of this accident, picric acid, the picrates, and their mixtures, with other substances, now come under the definition of explosives, unless wholly in solution or made and stored in a building exclusively appropriated and adapted for the purpose.

Only eight deaths have occurred in connection with the manufacture of explosives; the annual average for the ten years is 7·5. During the years immediately preceding the operation of the Explosives Act it was 37 per annum.

The Inspectors remark with pleasure that the workmen are very generally beginning to understand that the regulations enforced are for their benefit and protection. Local authorities, however, too often exhibit a lamentable amount of carelessness.

Only two prosecutions for irregularities have taken place. The secret and illegal manufacture of explosives for criminal purposes is by no means at an end, nor will it be until the local authorities are more vigilant, and until the public, whose safety is at stake, call attention to every suspicious circumstance they may observe. Special precautions are required to guard magazines against unlawful entry and abstraction of any portion of their contents. We should beg to suggest, in addition, the introduction of electric alarms, which would at once indicate any entrance after business-hours.

A source of danger to the public is the illegal conveyance of explosives under false names in railway-carriages. One man was found to have left 5 lbs. of dynamite on the rack of a carriage, labelled "Knives and forks." He was fortunately detected and convicted. Carts loaded with dynamite have been sent to mines without even a cover, and with none of the other precautions which the Act enjoins. Perhaps the most glaring case is one which occurred this year on the Thames below London. A fleet of barges, the property of a man who had contracted to convey live shell, gunpowder, etc., for Government, was left moored for some days without any men in charge. It is obvious that the heaviest penalty which the Act enjoins falls sadly short of the exigencies of such a case.

THE FIG TRADE.

THE ordinary edible fig, though in strictness a tropical or at least sub-tropical fruit, is capable of cultivation over a very large part of the temperate zones. The tree thrives in England and resists such winters as that which has just come to a close, whilst many native British plants have been destroyed in the same gardens. It ripens its fruit in the open air, in a fair season, not merely along our south coasts, but in south-western Essex and in sheltered situations, even in the Midlands. The fig tree has the great advantage that it is very rarely molested by vermin. Cats do not sharpen their claws against its trunk, but smell at it and turn away with an air of disgust. As a matter of course, the tree flourishes better and bears more luxuriantly in the south of France, in Spain, Italy, Greece, and Northern Africa. It is still better adapted to the climates of South Africa and Australia, where Baron Müller recommends it for cultivation on account of its power of resisting dry weather.

But whilst figs are thus produced over a very extensive part of the earth the dry fruit of commerce, the "Eleme," is obtained exclusively from one locality in Asia Minor, a slip of land in the fruitful valley of the Mæander, perhaps sixty miles in length by eight miles in breadth, beginning near the site of ancient Ephesus. This valley produces annually about twenty-five million pounds of figs, a great part of which are exported.

Of the many kinds of this fruit known to the horticulturist two only are cultivated on the large scale in the Mæander valley. There is a short kind, plump and pulpy, and of a deep purple colour approaching to black. This kind is preferred for eating whilst fresh, and is hawked about in the East to the well-known cry, "In the name of the prophet, figs!" A larger greenish-yellow kind is preferred for exportation, as it bears the packing and carriage better. The fig season begins about the end of August and finishes early in October. The fruit is not plucked, but allowed to fall when fully ripe. It is not injured by the fall, as the trees are not high, and as the fruit, moreover, grows by preference on the lower branches. But the figs when thus fallen cannot be suffered to lie even a day upon the ground, as they are then apt to turn mouldy and spoil. The whole rural population, men, women, and children, turn out in a body to collect the harvest in baskets. Layers of rushes or flags are laid upon the ground in some part of the gardens, fully open to the sun and not shaded by trees, and upon these the figs are spread out to dry. At first they touch each other but they soon shrink so as to leave intervals. In five days they are sufficiently dry for packing, and the sorting begins. The finest alone were formerly known as "Eleme," which is not the name of a place, but means chosen or selected, just as the finest quality of gum Arabic is termed "elect." Latterly the name has been given to all grades, except the poorest, such as are often sold threaded upon strings or rushes. Each grade is put separately into coarse, porous sacks of goats' hair. These allow a very free passage for the air, even if quite full, so that there is no danger of the fruit becoming mouldy. Each sack when full weighs about two quintals—say 250 lbs.—and in these they are conveyed upon camels to the nearest station on the line to Smyrna.

By one of those curious conventions which we encounter in nearly all countries and in all spheres of human activity, each camel must carry two such sacks. As camels differ among themselves in strength quite as much as do other beasts of burden, it often happens that one is overloaded whilst another could, without inconvenience, carry half as much more. But no one departs from the time-honoured routine.

The fig market at Smyrna consists of two dirty streets, in which the sacks are deposited on the ground so as barely to leave room for the camels to pass between.

To this market come Greek merchants, who act as middlemen, and who generally secure a larger share of the profit than falls to the lot of the cultivator.

These Greeks most commonly sell the fruit to the packers, and these in turn dispose of them to shippers. Sometimes, indeed, the shippers buy at once from the grower, who is represented by the *devegee*, the camel driver who has conveyed the crop to market. The *devegees* are always Turks, and as invariably honest, which can scarcely be said of all the other persons engaged in the traffic.

Next comes the packing—perhaps the most interesting, and certainly the least appetising, stage of the business. The first step is a re-sorting, executed by women. Then follows the "pulling." Each fruit is seized by a man who dips his hand into a can of salt water, flattens the fig between his fingers, gives it a peculiar pull which causes it to split at the stalk end, and lays it neatly in the box. For the cleanliness and the healthiness of these men there is no guarantee. It would be well indeed if these operations could be executed by machinery. The salt water is said to bring out the sugar of the fruit to the surface in about three months' time, and the fruit is then in the best condition for use. The best kind are mostly packed in boxes, and the intermediate qualities in drums, holding from 3 to 9 lbs., or in casks holding more than 1 cwt. Inferior grades are packed in bags, and serve for the manufacture of various concoctions.

We are told that such figs, from their multitude of "seeds," are found useful for mixing with strawberries and raspberries in the production of artificial jams, being boiled up with vegetable marrows, glucose, "fruit essences," and appropriate colouring matters.

Two remarkable facts concerning the fig are not generally known. The fruit is not, like a plum, an orange or an apple, a unitary product, developed from a single blossom. Every fig contains, or has contained, within it a multitude of blossoms, each of which becomes one of those tiny granules found embedded in the pulp, and erroneously called "seeds."

The second memorable point is that, although the fig is perfectly wholesome, the juices of the leaves and the bark are somewhat poisonous, which may account for its general immunity from the ravages of aphides, caterpillars, etc. Some of the near kindred of the common fig tree, such as *Ficus toxicaria* and *Ficus dæmonum*, are well known in India for their venomous character.

Abstracts of Papers, Lectures, etc.

ROYAL SOCIETY.

At the last meeting a paper "On the Electromotive Changes connected with the Beat of the Mammalian Heart, and of the Human Heart in Particular," was read by Augustus D. Waller, M.D. The electromotive properties of various animal tissues (muscles, nerves, glands, retina), and the changes which these properties undergo with activity have occupied a large share of the attention of physiologists during the last hundred years, since the memorable observations of Galvani and of Volta (1786-1798). And in recent years evidence of similar electromotive changes has been sought for and found even in man; two notable experiments are quoted in the physiological literature of this subject, by Du Bois-Reymond and by Hermann, to show that the contraction of human muscle is attended with electromotive changes. It cannot be said, however, that either of these experiments are free from doubt, nor that they furnish anything beyond a problematical illustration of facts which can be analysed only upon isolated tissues. The observations, of which a brief summary was given, deal with an entirely new aspect of the subject; they furnish a demonstration in man of the electromotive changes which accompany each contraction of the heart. The author states that it is possible, by leading off from various parts of the surface of the body to a capillary electrometer to observe upon animals and upon man variations of potential coinciding with and dependent upon the heart's beat, and he showed photographic records of these variations.

ROYAL HORTICULTURAL SOCIETY.

At the meeting of the Scientific Committee on July 24th, Dr. H. Scott in the chair, Mr. Prowright, in acknowledging the letter of thanks addressed to him some time since by the Chairman on behalf of the Committee, made the following remarks:—"It was my hope when I began my cultures that the general outcome would tend to a lessening of the number of the species of the Uredineæ. This, however, is not the case; on the contrary, I feel convinced that physiological investigation will show that these parasitic fungi are much more numerous than we at present imagine. To take one instance only, that of the Uromyces, which occurs upon beans. It is now generally thought that one species is common to most of the Leguminosæ. I have made a number of cultures on this point, and find that when *U. fabæ* from the common bean haulms is placed on young plants of bean, pea, *Vicia cracca*, *V. sativa*, *Lathyrus prætensis*, and *Ervum hirsutum* Æcidia are only produced on the bean and pea; and further, that the Uromyces on *Ervum hirsutum* applied to the same host plants produced Æcidium on Ervum only. In the same way the Puccinia which occurs upon the Compositæ is, I find, not one species, as is generally supposed, but that Uredospores from *Centaurea nigra*, for instance, will not affect *Taraxacum officinale*, neither will the Uredospores of *T. officinale* infect *Apargia autumnalis* nor *Lapsana communis*. Before the true affinities of these species can be satisfactorily determined numerous and long-continued biological investigations will have to be made for the hasty grouping together of the various forms, because they occur on allied host plants, is as liable to error as the opposite plan of making every form a species because it occurs on a different host plant."

Dr. Masters showed diagrams representing the movements in the shoots of firs, not only of the leader shoot of *Abies bifida* (*firma*), but also of the lateral shoots; while the leader shoot gyrates in irregular ellipses, its point being alternately raised or depressed, the lateral shoots not only move from one point of the compass to another, and are elevated or depressed, but are rotated on their own axis, the leaves also being raised or depressed at various angles. These movements of shoots and leaves were very complex, and in all probability dependent on different causes.

THE ARTIFICIAL REPRODUCTION OF VOLCANIC ROCKS.

Translation of a Lecture Delivered by M. Alphonse Renard, LL.D., at the Royal Institution.

(*Concluded from p.* 118.)

According to Sénarmont, one of the essential conditions of a geological synthesis, is that each artificial operation should be compatible with all the circumstances where the natural operation has left characteristic traces. The industrial slags and scoriæ, whose relation to some of the products of nature we have already discussed, are, in reality syntheses, but syntheses of chance, which, in spite of their great scientific interests, cannot be placed on the same level as the intentional syntheses which we will now examine, where the experimentalist, bearing in mind the problem to be resolved, endeavours to realise, in his laboratory, conditions identical with those which surround the formation of the natural products which he wishes to imitate.

In the order of logic, synthetical methods follow to a certain extent the progress of observation and analysis. Nevertheless, it must be admitted that since the earliest days of geology, a few master minds have, with the glance of genius, discerned the light which later experience has brought to bear upon this science. Buffon proved by experiments that granite and the principal crystalline rocks are fusible, and that they are transformed by fusion into a glassy mass. Some years later, Spallanzani worked out a series of experiments on the fusion of lavas, in order to destroy the reigning prejudices on the cause of the heat of the eruptive matter. But the chief honour is due to Sir James Hall, for the inauguration of geological research by means of numerous celebrated experiments, which he generalised and applied in the most masterly way. We can only consider here that portion of Hall's work which concerns the synthesis of rocks. About the time when Spallanzani was studying by laboratory processes the conditions of the formations of lavas, the illustrious Scotch geologist fused some eruptive rocks in a graphite receptacle, and observed that the products of this fusion, if abruptly cooled, gave an amorphous glassy mass, while a more gradual cooling induced the formation of crystals. James Hall had already learnt from experience the principal basis for future syntheses, viz., the fact that to reform crystals in a fused rock, the glass resulting from this fusion must be kept at a high degree of temperature, inferior, however, to that originally required for the fusion of the rock. During this annealing, certain minerals are able to crystallise. These facts can be compared with those furnished by recently ejected lava at the moment when the temperature begins to fall.

Towards the commencement of this century Gregory Watt directed his researches into the same path; he experimented on a mass of basalt 700 lbs. in weight. He fused it and let it cool down for eight days in a furnace, which was allowed to cool slowly. During this prolonged annealing sphærulithic concretions, composed of radiating fibres, about 6 centimetres in diameter, became isolated in the black opaque glass obtained by the fusion of the basalt, and finally this glass passed into a stony stage, becoming granulated and charged with very fine crystalline particles. At the same time its magnetism increased and its density grew from 2·743 to 2·949.

One conclusion arrived at by Watt's research, which resembled in many points that of Hall's, which we referred to above, is that while the molten mass is solidifying crystallisation can take place.

At the time when the path of the synthesis of rocks was thus being prepared, analysis and other means of investigation had not attained to the perfection of the present day; on the other hand, the prejudices which prevailed in the earlier days of geology had accumulated obstacles which were only surmounted at least half a century later. We cannot pause here to survey the brilliant period of mineralogical syntheses which followed closely on the impetus given by chemistry and mineralogy. It suffices to simply quote the names of Ebelmen, Rose, Mitscherlich, Sénarmont, to recall to the remembrance all the remarkable results of the artificial productions of minerals. But the researches of these scientists had reference chiefly to the synthesis of isolated specimens, and not to that of rocks themselves, which are the aggregate of mineral specimens. Generally speaking, these experiments were chiefly of a mineralogical order, and only secondarily lithological. Nevertheless, the efforts of these clever experimentalists solved many a geological problem, and they also proved the steady maintenance and accentuation of the tendency which leads the intelligent to seek, by experimental means, a more complete knowledge of natural phenomena. At last, in 1866, Daubrée reproduced crystalline rocks by simple fusion, and it was his method which was finally adopted and developed by MM. Fouqué and Michel Lévy. The researches of Daubrée to which we here allude, are those which he undertook in order to reproduce by fusion certain meteoric stones characterised by the absence of the feldspathic element. He fused an earthy rock, lherzolite, whose composition resembles that of corresponding meteorites, and succeeded in obtaining results which, in the details of structure and composition, faithfully reproduced those of the cosmic type which he wished to imitate.

At the time when this eminent geologist was thus anticipating the researches which some years after were to throw so brilliant a light upon the geological laboratories of the College of France, the progress of the synthetic method was still much hampered by hypotheses. It was no longer those relating to the influences of mysterious forces that had to be dealt with, but the supposition that the reproduction of geological phenomena in the laboratory was only possible at the expense of an indefinite amount of time, and of temperatures and masses of which, in the present day, we can scarcely form an idea. It was thought then that the mineral combinations in Nature followed other laws than did those produced by chemistry. These prejudices, however, were powerless to arrest Daubrée's progress on the road, on which by his synthesis of meteors he had so valiantly taken the first steps—for he, let us hasten to observe, is one of those whose labours have done most towards the eradication of these hypotheses from the domain of geology. But the methods of analysis in vogue in those days did not render penetration into the depths of the natural rocks and subsequent comparison of their internal structures with those of synthetic products at all possible. The laboratories did not possess the necessary apparatus for obtaining a very high degree of temperature or for maintaining it during lengthy experiments.

The great improvements in the construction of apparatus, and the application of the microscope to lithological work, have however facilitated the reproduction of all contemporary volcanic rocks. Two French scientists, M.M. Fouqué and Michel Lévy, who introduced micrographical lithology into their country, commenced in 1877 a series of synthetic experiments, thenceforth memorable in the history of science. One of them had acquired a well-earned reputation by his remarkable works on volcanic phenomena, which he had studied on the spot in several classic regions; he was familiar with all the secrets of the chemical analysis of minerals, which he carried out in the most ingenious and practical way. The other, well-prepared by his studies in the French colleges, had conducted with striking success an examination of minerals by their optical properties; he had carried on the application of exact methods in micrography further than had ever been done before, and had already made himself known in the scientific world by his researches on eruptive rocks of the ancient series.

In their conjoint labours, MM. Fouqué and Lévy to a certain extent systematised and arranged the facts relating to the chronological succession of crystals in eruptive rocks, and revealed a large number of the details which we have already mentioned among the results of lava analysis. It is to this happy association of talent, this fertile collaboration, that we owe the great discoveries which have rendered the College of France so celebrated, and to which I am proud to render homage here in presence of an audience ever ready to welcome all scientific progress, and at whose tribunal—the first in the world for the diffusion of science—the immortal Faraday has expounded with such generous ardour Ebelmen's wonderful achievements in mineralogical synthesis.

We have already indicated the data furnished by chemical and mineralogical analysis, which these scientists had as foundation for their attempts. One point which we have not yet touched upon, is the base of their general process. Theory would suggest that the most ancient crystals of an igneous rock should be the least fusible, and observation corroborates this theory, the minerals of the first period of crystallisation occupying the lowest place in the scale of fusibility. The constituent specimens of the lavas have appeared at successive times, according to their degree of fusibility, in proportions as the temperature fell. These facts, ascertained in detail by microscopic analysis, served as the point of departure for MM. Fouqué and Lévy's labours. Their process rests also partly on a fact which Sir James Hall had foreseen, viz., that the fusion of a rock produces an artificial rock more easily fusible than are any of its crystalline constituents. Now, if a natural rock be submitted to a very high temperature, and the glass produced by this fusion made to pass through a series of decreasing temperatures, always, however, higher than that of the melting point of the vitreous mass, the minerals which can crystallise in the magma are formed in due succession, the least fusible separating first. These crystals are eventually united and surrounded by those whose fusibility is greater, which appear in their turn as the temperature decreases. Without entering into the technical details of the apparatus, we will content ourselves with remarking that by the aid of the furnaces and tubes which MM. Fouqué and Lévy used for their synthesis, all intermediate stages, from glowing red to dazzling white heat, can be obtained, and a given temperature maintained undeviatingly during an unlimited period. Into a furnace is introduced a platinum crucible, of a capacity of about twenty cubic centimetres, containing the mixture of mineral matters which fusion, and subsequent annealing, are to transform into rocks. The following is the sequence of the operation: first, by the aid of special arrangements the temperature is kept at dazzling white heat, while the mixture is transformed into glass. By regulating the admission of gas and air, and by uncovering the furnace, the temperature of the molten mass is reduced to orange-red heat or about the melting point of steel. The crucible is then raised from the furnace, when the temperature decreases to cherry-red, or the fusion point of copper. Finally, if the crucible be taken quite out of the kiln, its contents can still be maintained at a temperature at which copper would only melt with difficulty.

We have sketched the broad outlines of the operation. It is practically a succession of annealings at diminishing temperatures, which force the crystals to form in a series commencing with the least fusible, and which give the texture and mineralogical composition of volcanic products to the molten matter subjected to this treatment.

We will explain, by a few examples, the mode of operation for lithological syntheses. Let us follow the method of reproduction of one of the rocks, which takes a prominent part in the eruption of Vesuvius, leucotephrite, a rock composed of leucite, labradorite, and augite.

A mixture is formed of silica, alumina, lime, ferrous oxide, potassium, and soda, which corresponds to one part of augite, four of labradorite, eight of leucite. This mixture is placed in the crucible at white heat, and transformed into a homogeneous glass. As soon as the fusion of the chemical compounds has taken place the temperature is lowered, and the vitreous mass is kept for forty-eight hours at the temperature of molten steel. The leucite crystals are formed during this first stage of the proceedings, which evidently corresponds to the first phase of the consolidation of eruptive rocks.

The mass is maintained for another forty-eight hours at the temperature of molten copper, and the whole residue left after the formation of the leucite crystals in the former phase is transformed into microliths of augite and labradorite, and octahedrons of magnetite and picotite. Now let us compare, after this double annealing, the microscopical preparation of the synthesis with natural lava; not only are the same minerals reproduced by this process of fusion of dry materials, but the order of their formation and the proportion of their constituents are identical; this analogy can be traced even in the details of crystallographical forms. Large leucite crystals are present showing all the characteristics of this mineral as found in Vesuvian lava, and grouped around them are the microliths of the second stage, augite and labradorite. Finally, as in the natural rock, the leucite contains enclosures of magnetite and picotite, which are the most ancient minerals.

Let us take for our second example the synthesis of basalt, one of the most widely diffused types of the volcanic series, anent whose origin numerous hypotheses have been advanced. It is well known that basalt is composed of three essential minerals—olivine, augite, and labradorite. The olivine appears in the natural rock as a crystal of the first consolidation.

As in the case of leucotephrite, a mixture of chemical elements or of pulverised minerals is formed, corresponding to the average composition of a basalt rich in olivine. The mixture is composed of three parts of this mineral, two of augite, and three of labradorite. It is first transformed into an almost homogeneous black glass, and maintained at red white heat for forty-eight hours. On examination of a thin section of this glass after this annealing at high temperature, large crystals of olivine are at once detected. These are embedded in a vitreous mass, in which little octahedrons of massicolite and of picotite are discovered, together with a few scarce crystals of augite.

We now have to induce the formation of the microliths of the second consolidation round the olivine crystals formed during the first phase. For this purpose the crucible is kept for forty-eight hours at a cherry-red heat, and after this annealing a paste is obtained composed of microliths of labradorite and augite, of magnetite, and of the glassy residue of this crystallisation. Thus in this second phase we have reproduced the microlithic structure. The basalts obtained by these operations can scarcely be distinguished from the natural rock, and these few grammes of cleverly manipulated substance supply us with a most convincing proof of the purely igneous formation of the rock.

We could mention here whole series of remarkable experiments carried out by MM. Fouqué and Lévy, whence we have obtained these two syntheses. All the contemporary eruptive rocks have been thus reconstituted; andesites, labradorites, basalts, limburgites, nephelinites, tephrites, leucite rocks, peridodites, and labradorites with ophitic structure. We will limit ourselves however to proving, by one last example, how these synthetic processes succeed in throwing a direct light upon the eruptive periods of the past formation of our globe.

Certain ancient crystalline rocks, common in the Pyrenees, were distinguished by the name of ophites. Neither the date of their formation nor their origin was definitely determined, until in 1877 M. Lévy proved that they were eruptive, and that they displayed under the microscope a peculiar structure which he designated by the name of *ophitic structure*, in which the felspar appeared united by very large tablets of augite. It thus appears that these ophitic rocks are igneous rocks in which the cooling down has proceeded much more slowly than in the ordinary products of contemporary eruptions. In endeavouring to reproduce the ophitic type by synthesis, it is necessary to crystallise the augite during a phase distinctly separated from that during which the felspar is produced, and to give ample time during the first period for the formation of the crystals into large spaces. For this purpose, a mixture of anorthite and augite was subjected, after fusion, to a preliminary annealing, during which it was kept for four days at the temperature of melting steel, when some anorthite separated. A second annealing of equal duration at the temperature of melting copper induced the crystallisation of augite in large masses, which formed a mould for the felspar, and attracted little octahedrons of magnetite and picotite to it. The eruptive origin of ophites and the cause of the structure were thus incontestably established by this noteworthy synthesis.

Thus we have convincing proofs of the service rendered by synthesis in enlightening us as to the origin of rocks, and in settling the discussions which, even in the present day, still arise apropos of the principal crystalline types of the modern epoch, as, for example, in the case of the basalts, in which some scientists would fain discover traces of aqueous agency, but in which, in common with all volcanic rocks of contemporary eruptions, these experiments tend to prove a distinctly igneous origin.

But scientists have not always obtained these magnificent successes; many of their attempts have proved utterly fruitless. It is advisable to recall these defects occasionally, as they point out which paths must be avoided if the final truth is to be reached. These failures circumscribe the field of future experiments and trace the limits within which hypotheses must be confined. Moreover, they show that these rocks, whose synthesis the methods employed have failed to gain, must have been formed under conditions differing from those by which actual volcanic products were produced. This conclusion, to which former analyses and observations already pointed, without, however precise certainty as to its causes, is amply confirmed by the failure of the synthesis. If it has succeeded in satisfactorily reproducing the lavas of modern volcanoes, it has completely failed in the imitation of those whose formation no longer occurs in contemporary eruptions. Broadly speaking, one may say that, up to the present, all the acid rocks have evaded synthetic formation, as, for example, all those which include, amongst their mineral constituents, quartz, mica, orthose, or hornblende. The processes of nature are not due to unknown forces; perchance, therefore, by combining those over which we already have control, by modifying their application we might eventually succeed in reproducing those rocks which up to the present have eluded our efforts, a hope which we may surely found upon the results already obtained, since they may be but the precursors of still more remarkable achievements. It is but a repetition of the axiom that the defeats of the past prepare the way for the victories of the future. We have endeavoured, in this rapid review of the progress of lithological synthesis, to show the high scientific importance of the researches instituted at the Geological Laboratory of the College of France. We might have enumerated the no less remarkable synthesis of minerals and meteorites, conducted with such good results by other clever scientists and their pupils, foremost amongst whom stands M. Bourgeois, but space fails us. Still we have at least sufficiently proved how much these methods have enlarged our knowledge in a domain of nature where all access once seemed denied to us.

Hitherto, wherever the torch of experimental methods has penetrated, it has fully and clearly illuminated the most striking phenomena of the science of the earth. To indicate the extent of the field of mineralogical science already explored by experimental science, it is only necessary to mention the name of Daubrée, the direct descendant of many illustrious geologists of the Scotch school. By degrees the processes have been successfully applied to the interpretation of metalliferous deposits, of metamorphic rocks, of the phenomena of trituration, and of the transportation of sedimentary matters, and to the study of the fractures and distortions of the earth's crust, of the schistosity of the rocks, and of certain features of the structure of the mountains.

Thus geology, after having passed through the successive phases of observation and analysis, has entered into the phase of experiments and synthesis, which endeavours to imitate the powerful creations of nature, thus crowning the scientific edifice by processes which facilitate the discovery of the several causes whose complete comprehension is the final aim of physical and natural science. It is this crowning triumph which Leibnitz presaged two centuries ago, when he wrote:—"He who succeeds in carefully comparing the products drawn from the depths of the earth with those of the laboratories, will accomplish a great work, for then at last we shall clearly see the striking similitude which exists between the products of nature and of art. Although the inexhaustible Creator has innumerable methods of carrying out His wishes, yet there is always a certain consistency even in the variety of His works. It is already a great step towards the perfect knowledge of causes and effects to have discovered a means of producing them, for nature is but art in magnified proportions."

CORRESPONDENCE.

The Editor does not hold himself responsible for opinions expressed by his correspondents, nor can he take notice of anonymous communications. All letters must be accompanied by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

WEATHER OF JULY, 1888.

In reference to *St. Swithin* and his mission this year, disappointment is expressed that the subject has not received as much attention from the weather-prophets as is usual at this time.

They have probably been content that the public are fully aware of the *old proverb*, which again has proved substantiated, and that it is known to be not an uncommon thing for July to be wet, as in 1879-80.

A collection of rainfall *observations at sea* in course of formation, and so far summarized, leads one to infer that our present weather is connected with undue prevalence of Atlantic weather.

This is driven to our islands by the numerous *cyclonettes, or minor depressions*, that have crossed them for some weeks at various latitudes, and carried with them clouds full of rain, which have been discharged on our coasts and hills.

In the *North Atlantic Ocean* the wettest months were January, June, and September, and the driest months were February, March, and April, and the wettest seasons were the autumn, and driest were the spring.

The wetness of the *present July* may therefore probably be explained by the rain-clouds of June and July at sea being wafted by the south-west winds from the North Atlantic Ocean over, towards, and across these islands.

These clouds of *aqueous vapour* are now rushing rapidly north-eastward to fill the dry vacancies in the air of the Arctic regions, coincident with the late draughts in northern latitudes, and these will continue to pass onwards until the *saturation* of the summer atmosphere takes place.

This may be accomplished by next month, August, when *finer weather* may be expected, as is usually the case at sea when but little rain falls, and the winds subside, and the sun is less obscured by clouds.

Anti-cyclonic weather will then advance from the south and from the Continent, with south and east winds, and a drier air will follow, as the breezes will then blow from the heated plains of Europe instead of from the warm surface of the Atlantic seas.

In contrast to the wet weather of June in the North Atlantic Ocean, and of July on land in Britain, it may be stated that June is a drier month in *South Atlantic seas*, and July is drier still than in the North Atlantic.

This year there has been exceptional weather at the *Cape*—much as it has been in Britain—and there April, May, and June proved to have been unusually wet, as in this country, on land, they have been unusually dry.

There would therefore appear to have been going on some kind of *reciprocity*, or give and take, between the weathers of the temperate zones of the North and South Atlantic Oceans, whereby the wet of one has been transferred to the other.

Easterly winds this month have been equally wet as the westerly ones, as they are seen to be only segments of the same circle of damp winds that form the other parts of the cyclonettes, or minor depressions, and are then called westerly winds, and both come from the Atlantic regions.

July, 1888. W. V. Black, F.R.M.S.

ALLEGED SHOWER OF FROGS.

A paragraph is going the round of the papers to the effect that, after very heavy and prolonged rain at Leamington, "the Tachbrook-road was covered with thousands of small frogs, which had fallen with the rain." Whilst fully admitting that small living animals have been carried aloft by whirlwinds and deposited elsewhere, I should suggest that the paragraph in question is a case of jumping at a conclusion. It is well known that when the ground is drenched with rain and the air saturated with moisture, frogs—especially young frogs—are apt to leave the ditches and the pools and hop about on what is ordinarily dry land. I should hesitate to admit that they had fallen with the rain, unless they were found on roofs or other localities out of their reach.

A. O. N.

"WHENCE COMES MAN?"

In the notice of my book, "Whence Comes Man; from Nature or from God?" in your issue of July 27th, there occurs a strange mistake, which I trust you will do me the justice to correct.

The writer of the notice says:—"For example, he (myself) quotes Spencer as follows: 'Self-existence, therefore, necessarily means existence without a beginning; and to form a conception of self-existence is to form a conception of existence without a beginning. Now by no mental effort can we do this. To conceive existence through infinite past time implies the conception of infinite past time, which is an impossibility.'"

The writer of the notice then quotes a part of my comment upon Mr. Spencer's assertion:—"When Mr. Spencer uses the word 'conception,' he is evidently thinking not of 'conception,' but of '*experience*.' Let us change the word 'conception' to the word 'experience.' To 'experience' existence through un-finite (it is so printed in my book) past time, implies the 'experience' of unfinite past time, which is an impossibility. Of course it is. But a *conception* of unfinite past time is not. It is simply the thought of time *without* limit; and is simply what I call a 'private' idea, the formation of which presents no difficulty."

It is on the last sentence that the mistake I ask to have rectified occurs. Instead of the words "a private idea," which is nonsense, the words in my book are "a *privative* idea," that is, the affirmation of time *without* limits—the "privation," or absence of limits. After having made such a mistake, it is not surprising the writer should have accused me of "rigmarole"!

I may be allowed, I think, to add that when the writer of the notice spoke of what he called the "astounding conclusion—the drift of the book—expressed in the statement of his belief that *space* is *God*," he might have stated at least some of the grounds of that conclusion, or at least the concluding words of my "belief," that *space is the mode in which the Infinite God manifests Himself to us*, and enables us to understand *how* it is that *in* Him we can "*live*," and "*move*," and "*have* our being;" how the Finite can "*co-exist*" with the Infinite, and the Infinite *remain* Infinite; how additions can be made to the sum of things, and the Infinite be Infinite as before. Arthur John Bell.

Easton Court, Chagford, Devon, Aug. 6th, 1888.

METEOROLOGICAL CONUNDRUMS.

Doubtless some of your readers will have noticed that when a season takes up a very decided character all the ordinary signs of a change of weather lose their importance. In 1879, and again in the present year, the indications of fine weather, such as a rising barometer, a rosy sunset, a grey, low dawn, a lofty flight of gnats and of swallows, were merely succeeded by wet and cold. On the contrary, in such seasons as 1868 the ordinary portents of wet and cold had no meaning. Now I should like to ask, what is the cause of a season taking up some special character? How can we ascertain the duration of such a state of things? Again, in Britain a thunderstorm almost invariably "breaks up the weather"—*i.e.*, is followed by northerly winds and a fall of temperature. Is the storm the cause of the cold, or is it an effect of the approach of the latter? Would-be Weather-wise.

NOISES ACCOMPANYING AURORAL DISPLAYS.

In reply to your correspondent, Mr. T. Todd, a number of people believe they have heard sounds accompanying the aurora borealis. The question has been carefully considered by Mr. Sophus Tromholt, who in March, 1885, despatched some thousand circulars to various parts of Norway, containing different queries regarding the aurora, and amongst them the following:—Have you or your acquaintances ever heard any sound during aurora, and, in this case, when and in what manner? He received answers to these queries from 144 persons. Of these, 92 (or 64 per cent.) believed in the existence of the aurora sound, and 53 (36 per cent.) of these again state they heard it themselves, whilst the other 39 cite testimonials from other people; only 21 (15 per cent.) declare they never heard the sound or know anything about it, and the other 31 (22 per cent.) have not noticed the query at all. There are thus 92 affirmations against 12 negations. The sound is described in these answers in the following manner:

Sizzling (3).
Breaking or sizzling.
An intermediate sound between sizzling and whizzling, sometimes as if a piece of paper were torn.
A kind of sound as when you tear silk; sizzling, th—ss.
Soft whizzing, alternative with sizzling.
Hissing and crackling.
Partly hissing, partly as a kind of rushing whiz.
Whispering and glistering.
Strong whiz (3).
Whiz or whipering.
Whiz, or distant, soft, continuous whizzing.

Constant Reader.

RECENT INVENTIONS.

The following list has been compiled especially for the SCIENTIFIC NEWS *by Messrs.* W. P. THOMPSON *and* BOULT, *Patent Agents, of* 323, *High Holborn, London, W.C.; Newcastle Chambers, Angel Row, Nottingham; Ducie Buildings, Bank Street, Manchester; and* 6, *Lord Street, Liverpool.*

BATTERIES.—Plates for secondary batteries have been patented by Mr. J. S. Stevenson. According to this invention, between the active material and the face of the mould is interposed a material which, whilst capable of withstanding the heat of the casting process, is preferably a comparatively slow conductor of heat and of a yielding character so that when the parts of the mould are forced together the active material is retained in place in the mould without fracturing or disintegrating the said material.

TELEPHONES.—An electrical telephone has been patented by Messrs. J. S. Ross and H. Baines. In this invention sheets of india-rubber are used for coating the surfaces of electrical diaphragms for protection from damp, and the adherence of the diaphragm to the magnet is avoided by arranging an electrical circuit, so that should the diaphragm be drawn on to its magnet the magnetising coil is cut out momentarily. The diaphragm will then keep vibrating, and by making a noise and by the use of an indicator, draw attention to the fact that the telephone requires adjustment.

FIRE-ESCAPE.—A fire-escape has been patented by M. Aug. de Waele. This invention embraces a movable step ladder applied to the front of a house between two windows or their balconies. The two spring-boards of this ladder form, with the hand-rails, a folding frame, in the form of a parallelogram, turning on two fixed pivots with which it is connected by means of rods. This step-ladder, when folded against the wall and fastened thereto, projects but a little way from it; when the fastening is undone it is easily opened out, thus forming a secure and easy exit from the building.

MAKING INCISIONS.—An apparatus for making incisions without pain has been patented by Mr. A. J. Boult on behalf of Mr. J. F. de Silva. Theapparatus consists essentially of a rectangular box which the operator holds with one hand, and containing multiplying gear wheels which he turns by means of a key held in the other hand. These gear wheels actuate by means of rods and cranks, a fly wheel and slide, the latter carrying a working catch which at a determined moment falls into a recess of a slide bar, and imparts to it and the knife a single rapid to and fro movement which makes the incision with such rapidity that no pain is felt as the exciting cause is immediately withdrawn.

CONDUCTING CABLES.—Means for making and insulating the joints of electrical conducting cables have been patented by Mr. C. D. Abel, on behalf of Messrs. Siemens and Halske. This invention consists essentially in the use of a flanged metal sleeve fitted on the cable, between the flange of which sleeve and the flange of a second sleeve the turned-up ends of the conducting wires are clamped so as to be in conducting contact therewith, the flanged sleeves serving for effecting the electrical connection to the second cable or conductor. In combination with this connecting device for the outer conductors of a cable a socket is used, fitted on the centra conducting wires of the cable, and provided with a pinching screw for connecting a conductor thereto.

ELECTRICAL CURRENT METER.—An instrument for measuring electric currents and for regulating electric machines has been patented by Messrs. W. Lowrie, C. J. Hall, and H. W. Kolle. In order to obtain a more sensitive instrument with a moderate length of wire, a wire is used suspended between two rigid supports, and has applied to it, midway between the supports, a weight of such power as to compel the wire, when heated by the current, to form an obtuse angle. The wire on either side of the weight may be considered as the radius of a circle, having one of the supports as a fixed centre, and any variation in length of the wire allows the weight to move along the apex of the angle to the point where two circles struck from the fixed centres with the altered radii would intersect. A maximum of deflection from the straight line is thus obtained, which deflection is caused to act on suitable multiplying and indicating mechanism, or mechanism for regulating electric machines.

ELECTRIC SIGNALLING.—An electrical signalling apparatus for railways has been patented by Mr. A. E. Nicholl. On the permanent way of a railway insulated wires are laid down, in connection with which are projecting bars placed at suitable distances from one another and arranged so as to be normally out of contact when laid down, but can be brought into contact when a locomotive passes over them. Every locomotive is provided with a metal plate for making contact with the bars, which are in connection with a galvanic battery, and also with electro-magnets on the locomotive, to which are attached signals for indicating to the driver that the circuit is completed. The insulated wires are laid down in predetermined lengths, and are so arranged that when a locomotive runs along the metals it will be connected with the laid wire. Should two locomotives come within the certain predetermined distance of one another their proximity will be notified to the driver by the magnetic signals being actuated on the locomotives.

MUSICAL INSTRUMENTS.—A musical instrument has been patented by Mr. E. Parr. The invention relates to musical boxes, but instead of being played by means of a roller with pins projecting from it which strike against vibrating tongues and thus produce the tune as the roller is revolved, it is operated by keys similar to pianos, which sound the vibrating tongues. A keyboard, carrying keys equal to the number of musical tongues, is employed, and opposite each tongue are arranged light levers, consisting of a star-shaped wheel turning on an axis, and having pointed arms the extremities of which, when the wheel is turned, press upon and force back the point of the tongue and then release it, the arm then passing on. In order that the wheel may be turned through a sufficient space by the pressure of the key connected with it, a lever connected with the latter is made to press upon one of the other arms of the wheel when the key is depressed. The end of the key or lever which so operates the wheel is hinged so that when the key is released it passes back and is ready again to sound the tongue when the key is struck by the player. Upon this instrument any tune may be played, and a considerable amount of expression given to it.

SELECTED BOOKS.

Water Engineering. A Practical Treatise on the Measurement, Storage, Conveyance, and Utilisation of Water for the Supply of Towns, for Mill Power and for other purposes. By Charles Slagg, A.M.I.C.E., author of "Sanitary Work in the Smaller Towns," etc. London: Crosby, Lockwood and Sons. Price 7s. 6d.

Forms of Animal Life. A manual of Comparative Anatomy, with Descriptions of Selected Types. By the late George Rolleston, D.M., F.R.S. Revised and enlarged by W. Hatchett Jackson, M.A. Second Edition. London: Clarendon Press. Price 36s.

A Text-Book on Steam and Steam Engines. For the Use of Students Preparing for Competitive Examinations, By A. Jamieson, C.E., F.R.S.E., Prof. of Engineering, Glasgow Technical College. With 200 illustrations and four folding Plates. Third edition. London: Charles Griffin and Co. Price 7s. 6d.

A Manual of the Mollusca. A Treatise on Recent and Fossil Shells. By Dr. S. P. Woodward, A.L.S. With Appendix by Ralph Tate, A.L.S., F.G.S. With numerous Plates and 300 Woodcuts. Fourth edition. London: Crosby, Lockwood and Sons. Price 7s. 6d.

Nature's Hygiene. A Systematic Manual of Natural Hygiene. By C. T. Kingzett, T.I.C., F.C.S., ex-Vice-President of the Society of Public Analysts. Third edition. London: Bailliere, Tindall, and Cox. Price 7s. 6d.

Handbook of the Amaryllideæ. Including the Alstrœmerieæ and Agaveæ. By J. G. Baker, F.R.S., F.L.S., First Assistant in the Herbarium of the Royal Gardens, Kew. London: Bell and Co. Price 5s.

NOTICES.

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METEOROLOGICAL RETURNS

For the ten weeks ending on Monday, July 30th, 1888. Specially prepared for SCIENTIFIC NEWS from official reports.

	Mean Temperature.	Rainfall.	Duration of Sunshine.
Scotland, East	52·4 degs., being 3·5 degs. below average.	8·0 ins., being 2·2 ins. above average.	387 hrs., being 33 hrs. below average.
England, N.E.	52·3 " " 4·4 " " "	8·5 " " 3·2 " " "	298 " " 113 " " "
England, East	55·7 " " 3·3 " " "	7·3 " " 2·1 " " "	328 " " 165 " " "
Midlands ...	54·9 " " 3·4 " " "	8·2 " " 2·5 " " "	318 " " 115 " " "
England, South	55·5 " " 2·6 " " "	7·6 " " 3·0 " " "	324 " " 138 " " "
Scotland, West	53·9 " " 1·4 " " "	9·8 " " 3·1 " " "	387 " " 39 " " "
England, N.W.	55·0 " " 3·0 " " "	8·6 " " 1·4 " " "	335 " " 87 " " "
England, S.W.	55·9 " " 2·4 " " "	9·1 " " 2·4 " " "	397 " " 78 " " "
Ireland, North	54·3 " " 2·3 " " "	10·4 " " 3·8 " " "	365 " " 22 " " "
Ireland, South	56·0 " " 1·4 " " "	9·8 " " 3·7 " " "	395 " " 10 " " "
The Kingdom...	54·6 " " 2·8 " " "	8·7 " " 2·7 " " "	363 " " 80 " " "

During the corresponding period of last year the rainfall for the Kingdom was 3·08 inches below, and sunshine was 86 hours above the normal.

Scientific News

FOR GENERAL READERS.

VOL. II. FRIDAY, AUGUST 17th, 1888. No. 7.

CONTENTS.

SCIENTIFIC TABLE TALK.

By W. MATTIEU WILLIAMS, F.R.A.S., F.C.S.

ON page 103 of the number of this magazine for August 3rd is a reference to Dr. Nasmyth's results. The mystery is, I think, explained by unconscious anticipation in my last paper, which was written before I saw the paragraph or the abstract on page 114. The old Welsh collier to whom I referred had learned by experience that he was less liable to lung and bronchial troubles in winter time while working in the pit than if occupied above ground. This was due to the luxurious temperature below, three or four degrees above that of the mean annual temperature of Flintshire, or about the same as that of the Riviera in winter. This uniformity of the temperature of the pits, so pleasantly cool in summer, so mild and genial in winter, is doubtless the cause of the comparative immunity of colliers from phthisis and other lung troubles.

It is well known that horses improve in condition while working in coal pits, and I know cases (one of my own among them) of ponies that after a few months in the pit have materially increased in market value, and have been sold accordingly. The difference is specially shown in the sleek condition of the skin or hair.

Experiments recently made in the Lake of Geneva have shown that the water is much clearer in winter than in summer. White discs submerged at different seasons prove themselves to be visible to a depth of above twenty yards in winter, but in summer disappear at little more than one-fourth of that depth. Corresponding results are obtained by comparing the depths at which photographic action is obtainable at different seasons.

Why is this? Some observations I made about thirty years ago supply an answer to this question. Domestic marine aquaria were then comparatively novel and much in vogue. I was a victim to the mania, and wasted much time upon it, trying in vain to grow the *Delesseria sanguinea*, and other beautiful sea weeds in an artificial rock pool with glass sides, and thereby carry out the theory that ornamental marine vegetation may under such conditions supply the oxygen demanded by the animals. I succeeded in demonstrating the fallacy of this, but discovered that another and very objectionable kind of vegetation was too easily obtainable.

I found that my tanks exposed to the sunlight of a south window, where like many other such amateurs I first placed them, rapidly become turbid, more like green-pea soup than limpid sea-water. The same occurred at about the same time in the first attempt at a public marine aquarium at the Zoological Gardens. The cause of this was the development of minute vegetation. Fresh water aquaria similarly exposed suffered in like manner, but not so severely.

My old friend, J. Alfred Lloyd, was a fellow-sufferer at the same period, but was more persevering, and made the construction and management of aquaria a business; established an emporium in the Portland Road, and afterwards designed and carried out very successfully the public aquaria of Hamburg, the Crystal Palace, etc.

His success mainly depended on his method of overcoming the turbidity due to such vegetation, and his practical abandonment of the theory of balancing animal and vegetable life in artificial aquaria, which Gosse and others, who merely wrote books on the subject, still maintained, and apparently have not yet learned to abandon.

Lloyd built his large aquaria underground, or in places effectively shaded from direct sunlight, *i.e.*, under conditions which checked as much as possible this vegetation that the book-theorists describe as essential. He not only did this, but he further exterminated the vegetation by connecting his tanks with a large reserve of water kept in total darkness, or the nearest possible approach to it. This is the case at the Crystal Palace. He also constructed, and, if I remember rightly, patented, a dark chamber adjunct to small domestic aquaria. Three sides of these were slate, only the front being glass; a sloping false bottom extended upwards from front to back, and contained beneath it more than half of the water in such darkness as to kill all spores and microscopic vegetation in the water, which entered the dark region by convection circulation.

The aeration of such tanks as those at the Crystal Palace is effected partially by a continuous circulation exchanging the dark-chamber water with that in the show tanks, and partly by jets of water carrying down adhering air into the tanks.

I may here remark, by the way, that air may be more effectively injected into an aquarium thus, than by forcing jets of mere air itself. The jet of air forms comparatively large bubbles, but the jet of water carries down with it a cloud of bubbles so minute that they expose a far larger surface, and rise but slowly through the water. The water jet should start from its nozzle at a very short distance above the surface of the water, a distance varying with the size and force of the jet. This can easily be tested by observing the dimensions and character of the cloud of bubbles produced.

Applying these experiences to the case of the Lake of Geneva, the explanation is obvious. In the summer the upper part of the blue water is made turbid by microscopic vegetation, which in the winter has little or no existence.

While Lloyd was making his experiments with shaded tanks and dark reservoirs, I was attacking the same problem chemically, and found that when the sea water thus became turbid it simultaneously became faintly alkaline. This I attributed to the removal of carbonic acid from the sea water, and the precipitation of some of the carbonate of lime that is present in all ordinary sea water, and is dissolved in excess of carbonic acid. This precipitation of course increased the turbidity.

To test this theory, I added, very cautiously and gradually, small quantities of hydrochloric acid. This effectually restored the transparency of the water, but did not meet with the approval of the animals. The actinia closed and became conical, and fishes were seized with fits of coughing, especially when I substituted chlorine-water, or bromine solution (both of which cleared the water) for hydrochloric acid.

A serious trouble arose at the opening, or rather intended opening, of the Crystal Palace aquarium. This was announced for Easter Monday. The tanks and underground reservoir, and duplicate pumping machinery were all punctually ready, and the sea water in its place, but although clear when poured in became quite milky in a very short time, and all the first stock of animals perished. At Mr. Lloyd's suggestion I was consulted by the manager, and soon discovered the cause. The water was alkaline, the alkalinity was due to caustic lime in solution, the caustic lime came from the Portland cement with which the underground reservoir was lined, and by which the rockwork of the tanks was held. Two courses were open for the remedy of this. One was heroic, the other cautious. The heroic remedy was to add sufficient hydrochloric acid to neutralise the dissolved lime, and to dissolve the precipitating carbonate; the prudent course was to go on circulating the water until the carbonic acid of the air gradually did the work. I proved the possibility of clearing at once by an experiment in an isolated single tank, but Lloyd had a dread of mysterious chemicals, and preferred the cautious course, which was carried out, but demanded a long time, and the opening of the aquarium was postponed accordingly. The complete success of this justified Lloyd's selection.

Influence of Trees on the Rainfall. — The reforestation of portions of North-western India is already exerting a beneficial influence by an increasing rainfall in the Southern Punjab, Southern Afghanistan, Northern Beloochistan, and Northern Scinde.

THE NATURALIST AT THE SEA-SIDE.

V.—Some Marine Larvæ.

THE larvæ of which we have to speak are the Ascidian Tadpoles, and the tiny creature long known as Actinotrocha, which turns out to be the immature state of the worm Phoronis. If the reader will forgive the alarming names which these minute and fragile animals bear, he will find that their acquaintance is well worth making. The Ascidian Tadpole is especially noteworthy in this, that while it resembles in nearly all essentials the more familiar tadpole of the frog and toad, it is destined to be transformed into something entirely unlike any amphibian, viz., a fixed and rooted leather-coated sea-squirt. Actinotrocha has something of the same peculiar interest, resembling as it does the larvæ of animals extremely different in the adult condition, such as echinoderms, various worms, and some mollusks. It exhibits a singular mode of transformation adapted to its own special needs, and unexampled in certain respects among other living things.

The Ascidian Tadpole is to be found swimming near the surface of the sea in bright summer weather, and is often taken in the tow-net. It is a small reddish animal easily seen by the naked eye, but requiring a microscope for anatomical examination. When the muslin of the tow-net is washed out in a glass dish, the Ascidian Tadpoles are at once identified by their rapid and peculiar movements. Pick them up with a dipping-tube and transfer them to a preservative fluid, when the details of their organism can be made out.

Like the tadpole of the frog the ascidian larva has a swollen "head" and a long swimming tail. The "head" in each animal is provided with paired slits by which the water taken in by the mouth passes out. The slits do not open directly to the exterior in the ascidian, but lead into a chamber which has its outlet in a spiracle at the back of the head. The tadpole of the frog exhibits precisely the same arrangement after the earliest stages of its free existence are past. Then there is a solid flexible fibre in the young ascidian, which agrees both in structure and position with the very similar notochord of the amphibian tadpole; the nerve-cord is almost identical in the two types, and both have the peculiar "cerebral" eye with rods and cones pointing inwards, and adapted to the reception of the rays of light received through the transparent brain.

The resemblances between the two sorts of tadpole are therefore by no means superficial, but extend to the most characteristic features of vertebrate organisation. The line once drawn so boldly between vertebrates and invertebrates is effaced by the Ascidian Tadpole, and for this reason, if for no other, our restless little larva is worth the most serious attention.

After its short term of activity comes to an end, the larva attaches itself by papillæ (which find their equivalent in the suckers of the amphibian tadpole), the tail is absorbed; some organs degenerate, while others become immensely developed; and what bade fair at one time to become an active, powerful, and intelligent vertebrate, sinks into a motionless sea-quirt with capacious mouth, stomach, and intestine, a stiff and insensitive skin, and a mere ganglion in place of brain and spinal cord*.

Actinotrocha is a very minute creature, just visible as a moving speck in surface collections. A lens or micro-

* A very interesting popular history of the Ascidian Tadpole is given in Lankester's "Degeneration."

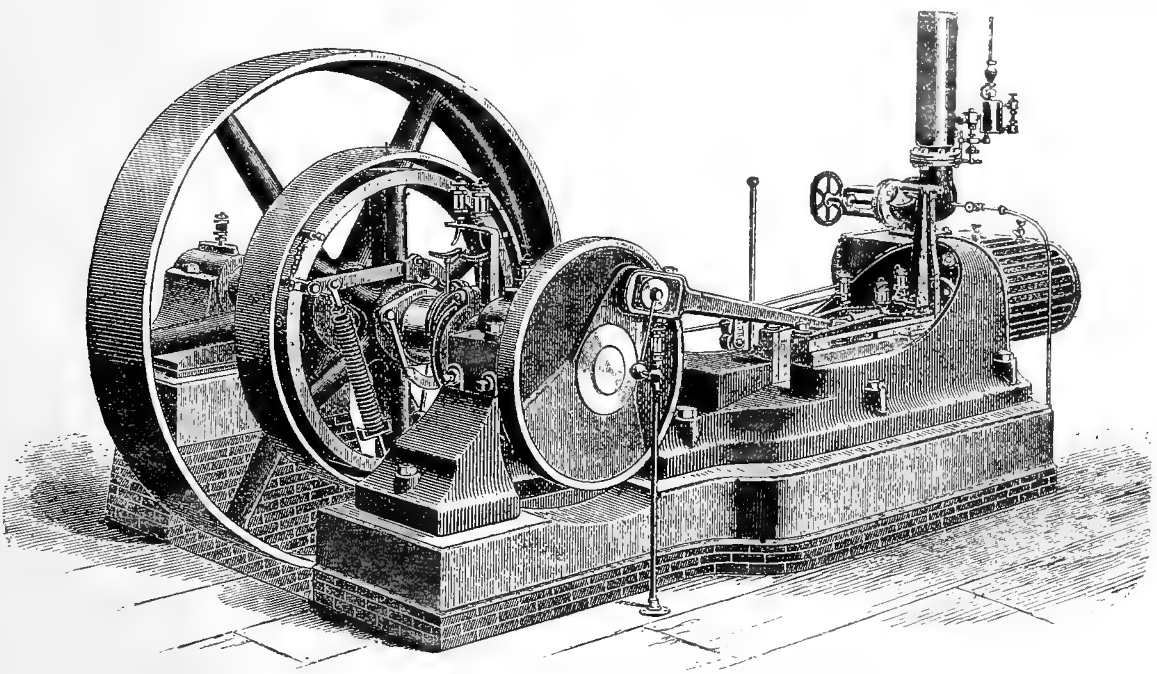
scope is necessary to make out its structure. It has a long transparent body, traversed by a simple alimentary canal, and provided at the head end with a crown of ciliated tentacles. Close to the other end is a ciliated ring. This condition is well suited to dispersal, and some kind of locomotive larva is, as we have more than once pointed out, a very common phase in the life-history of marine animals. But the adult form of our ciliated embryo is a tube-dwelling worm, known as Phoronis. The passage from the Actinotrocha to the Phoronis condition presents certain difficulties, which have been overcome in an interesting way. At first the intestine is straight, as in most worms, but this arrangement does not suit an animal which lives in a tube without outlet below. Accordingly the worm seems to have been led in the first instance to double itself up, so that the intestine ended at the mouth of the tube. In such worms as Sabella this simple resource persists without modification. One serious inconvenience results. The alimentary canal, and the whole body, are reduced by doubling to one-half of their original length—a great disadvantage to any animal which has to reach out of its burrow in search of food. Phoronis has solved the problem in a neater way than Sabella. It prepares beforehand a pouch opening on the side of its body near the head. This pouch gradually lengthens, and the tip, which, of course, is innermost, attaches itself to the slowly elongating intestine, which lies loose in the body cavity. When the moment of transformation comes, the pouch turns itself inside out, like a stocking drawn hastily off the foot, and henceforth constitutes the chief part of the body of the worm. The alimentary canal is at once drawn into it, and thus becomes suddenly bent into a loop, whose two ends are brought together at the mouth of the tube. In a quarter of an-hour the Phoronis is completely adapted to its new conditions.

Some animals, while undergoing transformation, change their bodies and their mode of life by insensible degrees, like a tradesman who gradually alters his shop and fittings, without stopping work for a single day. Others, like many insects, which lie up for a time as motionless pupæ, resemble the shopkeeper, who shuts up for a month in order to clear out his old stock and furniture. But Phoronis must be compared to the man who means to make his shop-door in a new place and add a room or two at the same time. He has all ready; all the new walls, and floors, and passages are complete, down to the door-knobs, and at last there is nothing needed but to shut one door and open another.

THE WILLIAMS SINGLE CYLINDER AUTOMATIC CUT-OFF ENGINE.

THIS engine has achieved such remarkable results as to attract the attention of leading engineers in the United States, so we propose giving a brief description of it.

As will be seen from our illustration, borrowed from the *Illustrated World*, the proportions are graceful, and



all the wearing surfaces very ample and of the best material. The distribution of steam and weight forces upon the bearings has been carefully calculated, so that no unnecessary strains shall be brought on any part.

One of the most valuable features, and one which is quite novel to engineering practice, is a construction of pressure plates which admits steam on their undersides, counteracting in a large part the pressure on their backs. No injury to the valve faces, therefore, can result from letting the plates "down hard" upon the valves, and when so adjusted the "high" portions of the faces will wear gradually away under the light pressures upon them, and the leakage, if there be any, will cease. When the wear has equalled the amount the plates were let down the plates will bear wholly on distance ledges at their ends, and the valves move freely under them. This feature furnishes an easy, safe, and sure means of keeping the valves tight. These pressure-plates do not, therefore, require that refinement of accuracy in fitting and adjusting which has been considered objectionable to other pressure-plate systems. The cut off valves have adjusting screws, easy of access, and the matter of adjustment for wear is simple. Besides, any leakage from these valves is excluded from the cylinder at about $\frac{5}{8}$ stroke by the main valve, and could not, therefore, result in any serious harm. The valves being, in fact, balanced, will wear but slightly, require very little attention, and never want to be replaced by new ones.

Another feature of this valve system is of the highest importance. The port openings are doubled for admission, cut-off, and release. This is one of the reasons for the exceptional economy claimed for these engines. A thorough separation of live steam from exhaust is another essential to economy accomplished by these valves.

Within the casing of the governor is an "inertia wheel," which acts in connection with the ordinary weight and spring forces. This feature is also novel, and produces a very admirable effect upon the action of the engine. The inertia wheel neutralizes the effect of the inertia in the governor weights, and assists the governor in overcoming the resistance of the cut-off valve. The weight and spring forces are made light, and consequently the action is free and rapid.

Messrs. Fairbanks, Morse, and Co., of Chicago, Ill., the makers, are also building compound condensing engines, and their performance justifies the prediction that there will be a large demand for them. The saving in fuel by compounding over single cylinder non-condensing appears to be about 40 per cent.; $2\frac{1}{2}$ pounds of coal per horse-power per hour is about what may be expected as the performance of these compound condensing engines.

THE COLOURS OF FRUITS AND FLOWERS.

SOME of us assert that the colouring principles of fruits and flowers owe their origin to a process of "natural selection." Others say, or at least said in days by-gone, that these pigments have in each case been mechanically determined by a direct creative act. But each of these explanations merely gives a final cause for their appearance, leaving the efficient cause or causes untouched. Yet surely the most interesting part of the question is to know how, when, and where the various colouring-matters have been formed, and by what agency they have been conveyed to and deposited in those particular parts of plants where we find them, leaving the other parts untouched. We almost fear that the popular study of natural selection has withdrawn attention from these questions. Naturalists have come to think that if they can only show how the development of intense colour in a plant attracts insects and promotes cross-fertilisation the matter is mainly explained, and *presto!* the colour must make its appearance.

We may in the first place remark that brilliant colour, alike in plants and animals, is most conspicuous at the epoch of maturity and in the most intensely vitalized portions of the structure. In plants at least, the distinct pigments hitherto recognised are very few. The white and black shades which we encounter—the latter very sparingly—are not due to any especial colouring-matter. White is due merely to the reflection of light through colourless tissues containing air. Blacks are generally due to the dense concentration of violet pigments. If we set aside chlorophyll green, which, though common in fruits, is rarely met with in flowers, we find, according to Dr. A. Hansen, the following three groups:—1, yellows; 2, reds; and 3, blues and violets.

As it was previously demonstrated by Hildebrand the yellows are mostly in combination with the plasmic substance, while the reds, blues, and violets exist mostly in solution in the cell-sap.

The yellow colouring matter of flowers forms an insoluble compound with fatty matters, as discovered by Krukenberg, and is named lipochrome. This fact goes far to explain the general comparative permanence of the yellow colours both of plants and animals. The yellow pigment obtained by Hansen in a crystalline condition agrees in its behaviour with lipochrome. The spectra of the pigments of different yellow flowers agree with each other so closely as to testify to their mutual identity. Between the F and G lines there occur two absorption bands, which do not occupy exactly the same position. The solutions are not fluorescent.

Orange is formed by a denser deposit of the yellow pigment. The colour of the rind of an orange is due to the same yellow pigment as that found in the flowers of *Ranunculus repens*.

The colour of yellow dahlias and lemon-rind is not lipochrome. It is soluble in water, and behaves differently both chemically and spectroscopically, displaying, for instance, no absorption-bands. It is very similar to the colouring-matter of *Aethalium septicum* examined by Krukenberg.

The reds of flowers, in Hansen's opinion, may be reduced to a single pigment, the dye of roses, carnations, peonies, etc. It is soluble in water, and is decolourised by alcohol, probably in consequence of dehydration. On the addition of an acid the colour is restored. The spectrum displays a broad absorption-band between D and F. The varying intensity of the colours of roses, carnations, and peonies depends, perhaps, on the presence of acids. The scarlets and brick-reds of poppies, scarlet lilies, hips and haws are doubtless produced by the joint presence of lipochrome.

The blue and violet pigments also turn pale in alcohol. The solution is reddened by acids, as was noticed by Fremy and Marquardt, who thence concluded that the reds were merely blue pigments modified by acids. Hansen, on the other hand, holds that the blue and the violet colours are modifications of the red. In support of this view he urges the fact that certain blue and violet colours (*Boragineae*) are at first red. On the contrary, we must remember that the corolla of many fuchsias passes from a bluish violet to a red, whilst the flowers of *Erica cinerea* open red and turn more to a violet on fading. Salts of iron, added to the soil, turn the red of peony flowers to a violet. Gardeners can also produce blue Hortensias by the use of iron. Peony red is turned to a violet by the addition of sodium phosphate, whilst larger quantities of the same salt turn it blue. The spectrum of the blue and violet pigments has two absorption-bands between D and *b*. These pigments may be combined with lipochrome yellow, thus producing the colour of the berries of *Ampelopsis*. Hansen assumes, therefore, only four fundamental pigments:—soluble yellow, lipochrome yellow, flower-red, and chlorophyll green. He opposes the view that all colours are derived from chlorophyll green, since the spectra do not agree.

The view that scarlets in flowers and berries are composed of a red pigment superposed upon lipochrome yellow, is strongly confirmed by the instance of bryony.

Its berries are first green, then take a bright yellow, and finally become scarlet. In the blackberry and the bilberry we see the development of blue and violet colours out of red, as both these fruits are red when half ripe.

SUN-DIALS, AND HOW TO MAKE THEM.—II.

THE next pattern to be considered is the ordinary horizontal dial. This may also be considered to be a thin slice of the globe dial, but in a horizontal plane. The axis, as before, points to the North Pole, and it may be either a thin wire or a stout gnomon; in the latter case the dial must be considered as though divided by the thickness of the gnomon.

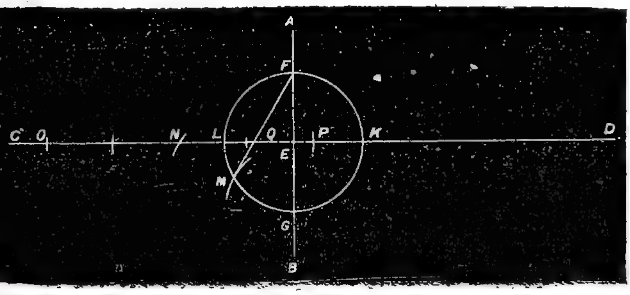


FIG. 7.

Fig. 6 (page 129) shows the horizontal dial as a slice of the globe. It will be seen that the divisions are no longer equal, but decrease in size as they approach XII.

There are a considerable number of methods of setting out the divisions; some of them are well worthy of attention, and those who care for pure geometry will find the subject full of interesting problems, ranging from the simple cases which are given in these chapters to the intricacies of spherical trigonometry, into which we shall not enter.

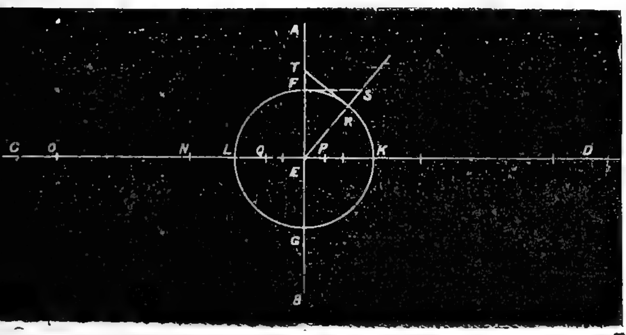


FIG. 8.

The least interesting method is to take the divisions from the following table of angles :—

Lat.	a.m. p.m. I XI	a.m. p.m. II X	a.m. p.m. III XI	a.m. p.m. IV VIII	a.m. p.m. V VII	a.m. p.m. VI VI	Tan. Co.Lat.
50° 0′	11°38′	23°51′	37°27′	53° 0′	70°43′	90°0′	·839
51° 0′	11°46′	24°10′	37°51′	53°24′	70°58′	90°0′	·809
51°30′	11°51′	24°19′	38° 4′	53°36′	71° 6′	90°0′	·795
52° 0′	11°55′	24°27′	38°14′	53°46′	71°13′	90°0′	·781
53° 0′	12° 5′	24°45′	38°37′	54° 8′	71°27′	90°0′	·753
54° 0′	12°14′	25° 2′	38°58′	54°29′	71°40′	90°0′	·720
55° 0′	12°23′	25°19′	39°19′	54°49′	71°53′	90°0′	·700
56° 0′	12°32′	25°35′	39°40′	55° 8′	72° 5′	90°0′	·674
58° 0′	12°48′	26° 5′	40°18′	55°45′	72°27′	90°0′	·625

The XII., or noon line, must be drawn first, and the VI. line at right angles with it; the other hour lines may then be set out with a protractor, but in the geometrical methods which will be given this instrument will not be required.

The last column in the table is the tangent of the co-latitude. This may sound rather alarming to non-mathematical readers, but it will be found useful in setting out the angle of gnomons for those who do not possess a good protractor. At the latitude of York, 54 degrees, to construct a gnomon for a horizontal dial draw a straight line 10 inches long, and at right angles to one end of it draw a line 7·20 inches long. Join the ends of these lines to form a right-angled triangle; this will be the shape of the required gnomon, the 10 inch side being the base and the 7·20 inch side the perpendicular. This side is generally cut in a fancy shape.

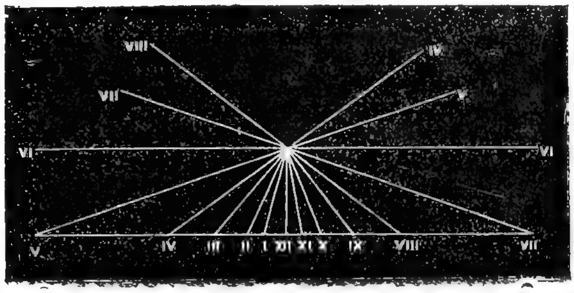


FIG. 9.

The first method which we describe for setting out the angles of the hour lines by simple geometry without the use of a table of angles and a protractor, was held in esteem by the old diallists for a curious reason—it can be produced by "only one opening of the compasses." Old books of geometry often describe figure methods of drawing figures with as few different openings of the compasses as possible; this seems to suggest that in the early days of instrument making the joints of the compasses were either so stiff or so ricketty that the less the legs were moved the better.

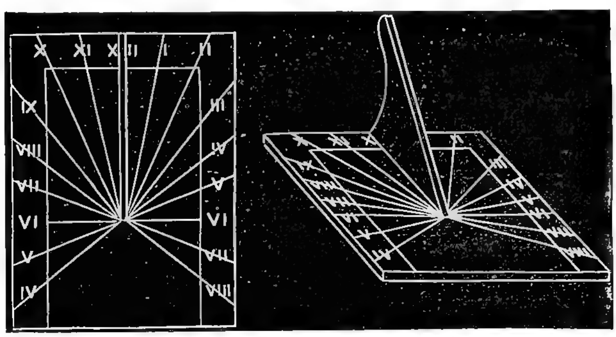


FIG. 10.

Draw two lines AB, CD, Fig. 7, intersecting at right angles at E. From E as a centre, with any convenient radius, draw the circle FKGL, cutting AB at F and G, and cutting CD at K and L. Then, keeping the compasses at the same opening, place one point at G and mark off M. Then turn from M to the point N, then make two steps to O and four steps back to P. Join MF, cutting CD at Q. The points ONLQEP, correspond to the hours V., IV., III., II., XII., and XI. The points found by repeating the process on the other side will give the points for the hours VII., VIII., IX., X., and I.

We have now to find the centre of the dial, or the point from which the hour lines radiate, this being also the point where the style, or the edge of the gnomon meets the plane of the dial. On the circle FKGL, Fig. 8, considering AB as the axis, and CD as the equator of the globe, mark off the point R, corresponding to the latitude of the place, the angle RED being the angle of latitude. This angle may be easily drawn by the aid of the table of tangents of co-latitude. EF being 10 divisions of any scale, and FS 17·95 divisions if the dial is for use in London. Draw RT at right angles to RE, cutting AB at T. T will be the centre of the dial. The triangle FSE represents the gnomon folded down flat. The hour lines may then be drawn through the points already found, as in Fig. 9. The hour lines for IV. and V. in the morning are merely extensions of the IV. and V. lines in the afternoon, and similarly for the VII. and VIII. lines of the afternoon.

A complete horizontal dial is shown in plan and in perspective in Fig. 10.

(To be continued.)

THE MATHEMATICAL ARGUMENT AGAINST ORGANIC EVOLUTION.

WE are about to examine, and we may venture to say, to refute an argument which was first brought forward by Prof. Fleeming Jenkin in the *North British Review* for June, 1867, and which at one time not only created some sensation but seems to have staggered even Charles Darwin.

The argument, strictly speaking, does not tell against evolution in general, but against evolution as effected mainly by Natural selection, or, as it is commonly called, "Darwinism." However, as the two terms are very commonly regarded as synonymous—it is by no means certain that Prof. Fleeming Jenkin understood their difference—it deserves brief notice.

Its author contended that if some advantageous peculiarity made its appearance on any given species it would probably be in the outset confined to one individual. If that favoured individual mated with one of the unmodified original type, its offspring would possess the distinguishing feature of the improved parent only to the extent of one half, and thus in the course of a few generations the improvement will be "bred out," and we have a reversion to the old type.

This argument is, of course, entirely founded upon the assumption that the offspring of any pair of animals will be intermediate, exactly or at least approximately, between their parents. Such an assumption is contrary to general experience. Were it well founded, a "family likeness" could never exist, since any peculiarities of an ancestor in face or figure would not be traced beyond at furthest the third generation. In reality we know that such likenesses are handed down for centuries. The "Bourbon nose" and the "Hapsburg lips" are matters of history. In not a few instances, where a family has been for a long time in a position to accumulate and preserve a series of ancestral portraits, its living members strongly and distinctly embody the features and expression of forefathers who flourished in the days of Queen Anne, or even earlier. Were such collections of portraits more general we should unquestionably find such hereditary likeness as common among the families of peasants as of kings and nobles.

If a momentary digression may be allowed, we should strongly urge the preservation of photographic portraits which are now within the scope of the great mass of the public, and which in course of time will become, from this point of view, valuable scientific documents.

But we may go a step, and a long step further. Any peculiarity, whether it be a new development or a reversion to some long-forgotten ancestral type, so far from necessarily disappearing in its offspring may even be intensified. As an instance, we quote from the *Journal of Science* (October, 1882, p. 623) the following passage, taken originally from *Land and Water*:—

"About twelve months ago, Mr. Peter Low, flesher, High-street, Montrose, bought a ram with four horns from a lady in town, which she had gained at a raffle at a church bazaar in Brechin. Mr. Low put the ram into a park with a black-faced Highland ewe, and the result was that the ewe gave birth to twins, male and female, on July 9th last, the male lamb having five and the female four horns, all well-developed."

We remember a similar case for which unfortunately we can give no details of place and date, but of the main fact of which we are absolutely certain. Every one knows that the domestic fowl has three toes in front, and the so-called spur behind the leg. A farmyard cock was found to have four toes in front, the spurs being developed as usual. This redundancy was transmitted to almost all his descendants, and four-toed fowls became—and are possibly yet—very numerous in the district.

Nor are cases in point wanting in the human species. We know an instance where a man having very dark hair and eyes married a blue-eyed fair-haired girl. One of the sons had eyes and hair darker than those of the father—the hair, in fact, being of the kind which novelists and poets call "purple black"—whilst another had the fair hair and blue eyes of the mother not in the least darkened.

Now, in all the cases which we have mentioned, the peculiarity thus transmitted to descendants has been of a kind not likely to confer any advantage in the struggle for existence. But if such useless abnormalities are transmitted, it is almost certain that advantageous variations are still more likely to be perpetuated.

The advantages gained by even a slight variation from the original type may be almost unlimited. Let us suppose a species of bird hard pressed by some enemy its superior in powers of flight. But if one bird of this species is produced swifter than the enemy, the chances of survival of this exceptional individual will be greater than that of any of the original stock, not by ten or fifty per cent., but, practically speaking, infinitely. If this bird, as we have seen it is possible, transmits its exceptional powers of flight to its descendants unimpaired or still more intensified, the original strain of bird will disappear, and will be replaced by what we may call the improved type.

Prof. Fleeming Jenkin thinks that as variations may take place in all directions, they will be likely to neutralise each other. But, in the instance we have just been taking, any variation in the direction of slower flight would quickly prove fatal to its possessor.

Hence, we see that even allowing—which we do not—natural selection to be the sole or main cause of the variation of organic forms, the contention of the *North British Review* is not of capital moment.

General Notes.

Australian Association for the Advancement of Science.—The first meeting of this Association will be held at Sydney on September 4th.

Alleged Cause of Leprosy.—In Turkey there prevails a notion that leprosy may be occasioned by a stroke of lightning.

Landslip.—There has been another landslip on the Scarborough and Whitby Railway, and traffic is again stopped. A few days ago a large part of the hill round which the line runs, after passing a place called the Peak, fell and blocked the rails. This was cleared, and traffic again resumed, but during Thursday night in last week there was another slip, and the line was again blocked.

Professor Brazier.—This gentleman is retiring from the Chemical Chair at Aberdeen University. Among the probable candidates for the vacancy are Mr. H. J. Jones, recent assistant to Professor Brazier: Dr. Orme Masson, professor of chemistry in the University of Sydney; and Dr. J. Gibson, assistant-professor of chemistry at the University of Edinburgh.

South London Polytechnics.—We understand that the Corporation of London will be asked within a very short time to exercise its well-known liberality in assisting the grand scheme now on foot, and certain of success, for creating in the south of London a series of polytechnic institutes for the education and advancement of the youthful portion (male and female) of our working population.

Registration of Plumbers.—At the City and Guilds Institute, Finsbury, last Saturday week, an examination was held under the auspices of the Company of Plumbers for Certificates of Registration. The practical examination included various branches of lead work, and the theoretical questions relating to the several subjects of plumbers' materials, house fittings and sanitation. Seventy-five per cent. of those attending passed the full examination.

Lightning Conductors.—Arrangements have been made by Mr. Edward Rigg, Recorder of Section G of the British Association, for a joint discussion on "Lightning Conductors," to be held in sections A and G at the Bath meeting in September. Mr. W. H. Preece, F.R.S., the President of Section G, will open the discussion, and Professor Oliver J. Lodge, F.R.S., will defend the position he took up this year before the Society of Arts.

The Preparation of Rhea.—The Board of Trade have received information through the Foreign Office to the effect that the opening of the competition of machinery and apparatus for the preparation of rhea, which was to have taken place at Paris on the 15th of this month, has been postponed till the 25th prox. The period during which applications for permission to compete will be received has also been extended to the 30th of August.

Meteor.—On Thursday morning in last week, at 2.30, a magnificent meteor was seen from Manchester in the south-west. The heavens were suddenly illumined by a splendid burst of light, caused by the explosion of the meteor. For at least three seconds after the white light had disappeared a well-defined train of red light could be seen depending, as it were, from the clouds. It would be interesting to know over what extent of country the flight of the meteor was observed.

Exploration in Morocco.—The following message from Mr. Joseph Thomson and Mr. Harved Crichton-Brown, transmitted by the Eastern Telegraph Company's cable from Tangier, has been sent to the Royal Society, the Royal Geographical Society, and to the friends of the explorers:—"City of Morocco, July 28th.—We returned to Amsmiz across mountains, safe and well, July 24th; many interesting geographical and geological notes; so far successful beyond our expectations. We were prevented going direct from Glamoa to Gundaffy by tribal revolt. We shall start on August 6th for third trip across the Atlas, further S.W. this time."

The Greenland Expedition.—The captain of a whaler which arrived at Sandefjord on August 4th reports that he fell in on July 10th with the ship *Jason*, having on board Dr. Nansen, of Bergen, and his companions in the journey on snowshoes across Greenland. The *Jason* was to have landed them at the east coast, but the first attempt had been a failure, owing to heavy weather and fogs. In order not to lose the seal-hunting season, the *Jason* had turned southward again; but it was the intention to shape a northerly course soon after July 10th, when another effort would be made to land Dr. Nansen and his party of explorers. Heavy masses of ice were reported along the coast.

Suicide Contagious.—Most of our readers will have heard of the sentry-box at Paris in which a number of sentinels hanged themselves in succession, until it was destroyed by the order of the Emperor. Every one is aware how persons came sometimes from a distance to fling themselves over the Highgate Archway, to the grievous peril of passengers on the road below, until a lofty iron fencing rendered this mode of self-destruction impossible. The same curious trait of human nature is now being manifested at the Clifton Suspension-bridge, which is about to be caged in with iron trellis-work from end to end. A similar fascination attaches in Paris to the Vendôme column and that of the Bastille, which are about to be caged in a similar manner, for the protection not merely of the madmen in question, but of those passing below.

Crystal Palace School of Practical Engineering.—On Saturday afternoon Mr. Arthur T. Walmisley, C.E., President of the Society of Engineers, awarded the certificates gained by the students of the Crystal Palace Company's School of Practical Engineering, the distribution taking place in the south tower of the Palace. Mr. F. K. J. Shenton read the report, which stated that out of thirty-two students who had attended the lectures on "Railways, their construction and appliances," twenty-two proved eligible for examination, and eighteen satisfactorily passed. The result of the examinations in the various sections was of a most satisfactory nature. Mr. Walmisley, in addressing the students, said that the report showed that good work was being done in the school. He could speak with a practical knowledge, having examined in the civil engineering section two years ago. Civil engineering was world-wide in its work, and could claim to have done a good deal towards the civilisation of the globe. Engineers must go before the missionaries to make the roads and provide water for them. The work of the students then on view displayed great aptitude on their part and reflected credit on the teachers. Mr. J. W. Wilson, the principal, said the school had been established sixteen years and that was the forty-seventh occasion upon which certificates had been awarded. Between 700 and 800 students had passed through the school, many of whom were doing well. He mentioned that seven or eight of their old pupils were now engaged as engineers in the construction of the Manchester Ship Canal.

National Co-operative Exhibition.—On August 18th an exhibition of the skill of workmen in their own trades will be opened at the Crystal Palace in connection with the National Co-operative Festival. The competition will be amongst working-men members of the Industrial Co-operative Societies throughout the kingdom, and the special facilities offered to them to compete, by their respective societies agreeing to pay carriage on all exhibits, should open the door to a very large and representative display of individual work. The prize list is a good one, and the Council of the Society of Arts—who have promised to appoint the judges—will also award one of their bronze medals in eighteen of the principal classes. The Secretary, Mr. W. Broomhall, 1, Norfolk Street, Strand, will supply any further particulars.

Earthquakes in Norway.—Dr. Hans Reusch, of the Norwegian Meteorological Institute, who is engaged in collecting particulars of the earthquakes which occur in Norway yearly, has issued his report for 1887, from which it appears that earthquakes are far more frequent in Norway than has hitherto been imagined. Reports were received of twenty-three, all of which were faint except three. One occurred on the night of May 7th, in the Bommel Islands, on the west coast, and was accompanied by subterranean detonations; another in the islands of Værö and Röst, at the extreme point of the Lofodden group, where doors and windows clattered, and the slates on the roofs were pitched off. Again, on November 5th, a severe shock of earthquake was felt at Bodö, on the north-west coast. Of the minor shocks those which frequently occurred on the Ytterö are particularly remarkable, as this island lies far out in the ocean, off the coast of Söndfjord.

The Public Health.—The Registrar-General reports that the deaths registered last week in twenty-eight great towns of England and Wales corresponded to an annual rate of 16·0 per 1,000 of their aggregate population. In London 2,530 births and 1,309 deaths were registered. In allowing for increase of population, the births were 87, and the deaths 473, below the average numbers in the corresponding weeks of the last ten years. The annual death-rate per 1,000 from all causes, which had been 15·7, 15·8, and 15·9 in the three preceding weeks, was again 15·9 last week. During the first five weeks of the current quarter the death-rate averaged 15·6 per 1,000, and was 6·0 below the mean rate in the corresponding periods of the ten years 1878-87. The 1,309 deaths included 29 from measles, 18 from scarlet fever, 19 from diphtheria, 25 from whooping cough, 9 from enteric fever, 121 from diarrhœa and dysentery, 4 from cholera and choleraic diarrhœa, and not one from small-pox, typhus, or ill-defined forms of continued fever; thus, 225 deaths were referred to these diseases, being 278 below the corrected average weekly number. The deaths referred to diseases of the respiratory organs, which had been 166 and 160 in the two preceding weeks, rose last week to 167, but were 25 below the corrected average. Different forms of violence caused 49 deaths; 42 were the result of negligence or accident, among which were 17 from fractures and contusions, 5 from burns and scalds, 5 from drowning, and 9 of infants under one year of age from suffocation. In Greater London 3,318 births and 1,593 deaths were registered, corresponding to annual rates of 31·3 and 15·0 per 1,000 of the estimated population.

Archæological Congress.—The annual congress of the Archæological Institute was opened on Thursday in last week, in the New Municipal Buildings at Leamington. In the Architectural Section Chancellor Ferguson read a paper on the "Castles in the District." This was followed by one on "The Great Wall of China," prepared by Mr. E. T. C. Werner, of H.B.M. Legation, Pekin. In the afternoon the members of the Institute paid a visit to Warwick. At St. Mary's Church the Rev. J. Case read an interesting paper on the building itself; and Mr. A. Hartshorne, F.S.A., commented upon the monuments in the Beauchamp Chapel. From there the party proceeded to the Museum, and subsequently visited Leycester's Hospital and the Castle, where Mr. Hartshorne read a second paper, and Professor E. C. Clark described the famous "Warwick Vase."

On Friday a visit was made to Baginton Church, where Mr. W. G. Fretton acted as guide over the church and the site of the ancient castle. From Baginton the party made their way on to Stoneleigh, where the ruins and remains of the ancient abbey were explained and commented upon by Mr. Fretton. They then inspected the modern mansion of Lord Leigh, and the pictures and other treasures belonging to the family. They also were shown the interior of Stoneleigh Church, with its fine Norman doorway, chancel arch, and curious font, and other decorations and monuments, including that to the Duchess of Dudley, who was a daughter of the noble House of Leigh. Their next halt was at Kenilworth, where Mr. Hartshorne acted as their guide and interpreter, showing them the ground plan of the castle as it was in the days of Elizabeth, almost surrounded by the lake, now dry. Leaving Kenilworth, they went on to Guy's Cliff, and were conducted through the little chapel and hermitage by Mr. Hartshorne.

On Saturday the ancient city of Coventry, so rich in mediæval buildings and events, was visited. Mr. W. G. Fretton, F.S.A., acted as guide. Among the places specially examined were St. Mary's Hall, St. Michael's and Trinity Churches, the Benedictine Priory and the site of the ancient Cathedral Church of Coventry and the Hospitium adjoining. The remains of the ancient walls and gates of the city were next inspected, and then St. John's Hospital, so long used as a free grammar school, the Collegiate Church of St. John, and the Bablake Hospital. After lunch Mr. Fretton conducted the members over the Palace Yard, the buildings of the White Friars or Carmelites (now used as the Coventry Union), St. Anne's (formerly the Carthusian Monastery), the Park Walls, the Manor House of Cheylesmore, the Grey Friars (now Christ Church), and Ford's Hospital.

WHIRLWINDS AND WATER-SPOUTS.—II.

(Continued from p. 78.)

THE whirlwinds which I observed on the ridges of our high mountains (where the snow is generally agglomerated in a manner more or less compact) so that the whirlwind can only raise up a sort of very dry rime, of a very slight density, present, on a reduced scale (2—6 yards in height) the same form as the dust-whirlwinds seen on dusty roads, *i.e.*, that of an inverted cone. On the contrary, the snow whirlwinds seen on the great tablelands, where the snow is plentiful and powdery, exhibit the aspects of the terrible sand-pillars of the deserts (Fig. 3). Hence it seems to me that the density of the materials lifted up modifies decidedly the general form of the whirlwind, beginning even with its *base of suction*, being acute in the one case and wide in the other. Evidently the existence of conical whirlwinds raising up snow and sand indicates a very considerable intensity.

In conclusion, R. Duhamel records his conclusions as follows :—

Everything conspires to demonstrate that the whirlwind itself presents an ascending force, so that in its whole mass the current sets from below upwards.

In mountainous regions whirlwinds occur by preference in certain places, rounded ridges, large open hills, enclosed ravines (forming in a manner chimney-shafts), high plateaus and points in valleys situated below currents of air coming from passes which open above them.

M. D. Colladon, of Geneva, forwards to *La Nature* some further observations on the same subject :—

"I have read with much interest M. H. Gilbert's note on the whirlwind which he studied at Vincennes. The most important matters are the formation of the point of the whirlwind and the direction of the rotation, which is that of the hands of a watch."

In 1879 I noted down the following particulars on a whirlwind which I watched for some minutes :—

"On a fine day in July, and in very calm weather, between 11 a.m. and noon, I was passing along the Boulevard de la Coulouvrenière at Geneva, near a stony place, where a great quantity of linen articles of different sizes had been laid out in the sun to dry. All at once a whirlwind with a perpendicular axis, and two or three yards in diameter, rendered distinctly visible by the rotation of a wave of dust, passed over this piece of ground spread with linen, and turned a part of them over, carrying them up at a dizzy speed above the roofs of the town, where all these articles continued to whirl about describing divergent cycles. Finally, at a height of at least 600 to 700 yards these articles were scattered in in different directions. This was evidently a whirlwind with an ascending rotatory movement. The column appeared, at the outset, to have the form of an inverted cone. All the objects lifted up were drawn into the interior, and then transported by the impulse of the air. Such momentary whirlwinds sometimes occur in calm and hot days in spring and summer, but they are visible only if there are at their place of origin light bodies or abundance of dust, and hence they often escape observation."

If the whirlwind just described had not carried away with it the linen, it would have ceased to be visible at the height of thirty or forty yards.

Whirlwinds in which the air ascends spirally have been seen in various countries, in dusty plains, and generally in calm weather. Their form has been compared by Humboldt to a funnel, the point of which rests on the ground. In his "Pictures of Nature" he speaks of whirlwinds of this kind observed in the Llanos of Venezuela.

Mr. Stephenson has observed similar phenomena in the province of Behar on certain dusty plains near the Ganges. He describes at the confluence of the Ganges and the Sone two enormous dust columns of more than four yards in diameter, the summit of which was lost in the atmosphere.

M. Adrien Arcelin, of Saint Sabin, sends to *La Nature* a notice of a similar phenomenon recorded in 1873, near Solutre. "A quire of so-called straw-paper which I used for wrapping up objects collected in the excavations, and which was lying on the ground at our feet, was whirled into space. All the leaves parted company, and began to rise turning over along helicoid trajectories which became gradually larger. It was curious to see these twenty-four sheets of paper whirling in the air like a flock of birds. They went far beyond the summit of the rock which rises 90 yards above the place where we were standing, and they lost themselves in the sky in the direction of Vergisson. The whirlwind was, therefore, moving in a

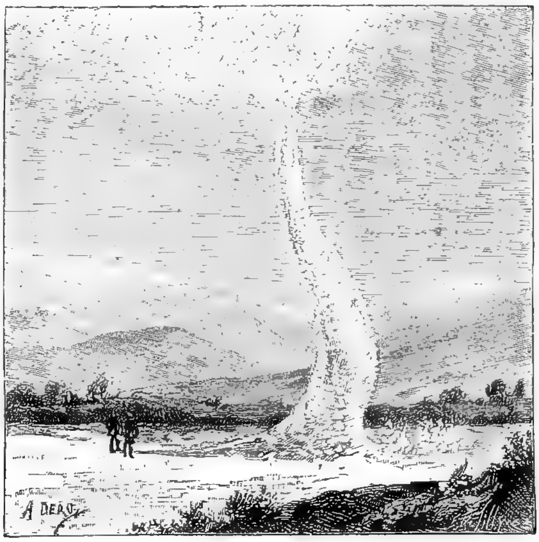


FIG. 3.

north-westerly direction. The time was 4 p.m. The weather was delightful, the sky clear, and the air calm both before and after the event.

Our party of ten labourers who were sitting on the ground, eating, at the distance of about 20 yards, felt nothing. There was no cloud of dust, as the ground was overgrown with grass, and had it not been for the paper the phenomenon would have quite escaped observation.

FAYE'S COMET.—Faye's periodic comet was seen near the calculated position by an observer at Nice Observatory at twenty minutes after three on Friday morning. The position was—right ascension 5h. omin. 28sec.; North Polar distance 69deg. 59min. 18sec. Comet Brooks was in right ascension 10h. 22min., and North Polar distance 45deg. 11min. at ten p.m. on the 9th inst., and the daily motion was $7\frac{1}{2}$ minutes decreasing right ascension and 9 minutes increasing Polar distance.

OUR KNOWLEDGE OF THE BACTERIA.

(*Continued from p.* 109)

THE forms which bacteria assume have been known for a couple of centuries. Van Leeuwenhoek, of Delft, an observer to whom we are indebted for an abundance of microscopic discoveries, saw in the year 1683, merely with single lenses of his own grinding, the now well-known bacilli, micrococci, and spirilli. Further observations showed the frequent and plentiful occurrence of these beings in the most different localities and under varied conditions. This circumstance, as well as the apparent impossibility of preventing their appearance and multiplication, gave rise to the thought that they were a product of *generatio aequivoca*. The first protest against this view was raised by Spallanzani, in 1769. He found that in infusions of plants contained in vessels which had been closed and were then heated for a long time the development of these micro-organisms—or as they were then called animalcules—did not take place. But on the free access of air which had not been heated they promptly made their appearance. Hence he argued that these microbia were not a product of spontaneous generation, but were developed from pre-existing germs. His opinion, long contested, was at last definitely and victoriously established by the researches of Pasteur.

The reason why these microbia were at first ranked among animals was their swarming motion. Not until the middle of the present century they were removed from the animal kingdom by Perty, Cohn and Nageli in accordance with their physiological properties and grouped along with the fungi, under the name Schizomycetes. It appeared that in certain essential points they present the same vital relations as do fungi. By reason of their want of chlorophyll they are not able to decompose the carbonic acid of the atmosphere and thus to obtain their supply of carbon. They are therefore restricted to a nutrient medium containing organic substances, animal or vegetable, *i.e.*, higher compounds of carbon. Without such a medium they cannot exist.

This is the case with the bacteria, which are never able to decompose carbonic acid. Both ordinary fungi and bacteria require a large proportion of nitrogen, and are therefore limited to a nutrient medium rich in that element. But not all bacteria and other fungi require organic compounds of nitrogen; many of them are able to assimilate even the simplest, such as nitric acid and ammonia.

Germs of bacteria susceptible of development may be found everywhere in the air around us, in the water, and in the superficial layers of the soil. Being suspended in the air or adhering to particles of dust they are driven by the wind against the surfaces of our walls, our furniture, and our clothing, and are always to be found there. Only on the loftiest peaks of snowy mountains and far out upon the ocean, remote from the land, is the air found free from such germs. The surface of our bodies, in health, is covered with bacterial germs, and not merely the external surface. With every breath of air they find their way into the mouth, the nostrils, and the respiratory organs. With every morsel we eat, and with every drop we drink, bacterial germs enter the mouth, the throat, the stomach, and the bowels. The secretion of the mucous membranes, and the other organic masses, which they here encounter, supply them with scope for multiplication. We must not, however, suppose that each and every kind of bacteria can prosper in any nutrient medium suited for bacteria in general. On the contrary, bacteria have their likes and dislikes, and every species requires particular kinds of nourishment.

In the growth and the multiplication of bacteria there occur a great series of phenomena all reducible to the circumstance that the complicated compounds of which their nutrient medium is composed are reduced to simpler ones by their vital process. There are thus produced the simplest chemical bodies, such as carbonic acid, hydrogen, hydrocarbons, sulphuretted hydrogen, and ammonia. During this decomposition of the nutrient medium we meet with the formation of the most varied ferments. Thus there are bacteria which generate ferments capable of converting saccharose into glucose, and also starch into glucose, which dissolve (peptonise) coagulated albumen and congealed gelatine, and which coagulate milk. Other bacteria effect the most manifold fermentations, and others, again, occasion the different phases of putrefaction, *i.e.*, decompositions of nitrogenous organic masses—with liberation of evil-smelling products. These latter processes have been for the first time closely studied by Pasteur. This able inquirer discovered the important general part which the bacteria play in the household of nature, reducing the complicated organic compound (formed by the life of plants and animals from inorganic substances) to the simplest states, and thus completing the circulation of matter. Among the chemical compounds produced in the vital process of bacteria, a prominent place is due to the so-called *ptomaines*, nitrogenous compounds of a basic character, some of which, known as *toxines*, are intensely poisonous.

We may lastly mention that many bacteria can elaborate from the substance of their nutrient medium colours, some of which are wonderfully beautiful. Others develop in their transparent nutrient medium a splendid fluorescence, whilst others give out in the dark a phosphorescent light.

HONOURS AT THE LONDON UNIVERSITY.—The honours list of the London University Intermediate Examination in Medicine, in July, shows a remarkable performance on the part of the candidates sent up by the London School of Medicine for Women. The total number of places obtained in honours by men and women was twenty-one, and of these the men took eleven, and the women ten. Owens College, Manchester, Middlesex Hospital, King's College Hospital, St. Bartholomew's Hospital, each obtained one place. From University College four successful candidates obtained seven places, but from the London School of Medicine for Women seven candidates obtained ten places. It should be noted also that only five out of the large number of men's schools have succeeded in getting a place in the honours list, while a small and comparatively new school, such as the one for women, has secured ten places.

THE NEW RECTOR OF LEIPZIG UNIVERSITY.—Dr. Franz Hofmann, Professor of Experimental Hygiene and Director of the Hygienic Institute in Leipzig University, has just been chosen Rector of that seat of learning. There is no higher name in Continental state medicine than that of Professor Hofmann, as all who remember the greeting accorded to him at the great Vienna Congress of last year will understand; and the German journals, professional and lay, are hailing his election as proof that public sanitation is becoming daily more prized in the great centres of scientific education.

Natural History.

THE RATEL (MELLIVORA RATEL).

Among the distinctive peculiarities of animal, or at least of mammalian species, one of the most curious, and at the same time most generally overlooked, is the comparative tightness or slackness of their skins. In ourselves, and in our nearest "poor relations," the apes and monkeys, the skin fits very tightly over the body. On some parts of our frame only, such as the knuckles, the elbows, and the knees, there is a loose fold of skin to allow of the free play of the joint. In some of the lower mammalian forms, those especially which coil themselves up into a kind of ball when asleep, the skin is of necessity very loose, like a coat too large for the wearer. This arrangement occurs more or less in the porcupines, the hedgehogs, but perhaps most of all in the uncouth-looking animal whose portrait we borrow from *La Nature*. So loosely clad is this creature that, familiarly speaking, it can turn round in its skin; and if seized almost by any part, it can thus contrive to inflict a bite upon the hand, or paw, or head of the aggressor. In the ratel, or beejoo, the skin is, in addition, very thick, and the fur dense and compact. If we inquire into its habits and its way of earning a livelihood, we may easily see that the structural features just mentioned are exactly such as are likely to have been developed by natural selection. It lives in Africa and India; it is a nocturnal, burrowing animal, and its favourite food is the comb of the wild bee, full of honey and young brood. Had the ratel, therefore, such a skin as men or monkeys, it would be infallibly destroyed by the stings of the insects whom it seeks to plunder. Even in England a hive of bees, when thoroughly enraged, is a formidable antagonist, but in tropical climates,

The Ratel.

where the swarms multiply all the year round, and may amount to hundreds of thousands, the only safety lies in a speedy retreat. But the coat of the ratel is practically impenetrable to the stings of bees, wasps, and hornets. The ratel cannot climb, and hence, if a swarm of bees have made their nest in the hollow top or branches of some huge tree, they are safe from their greedy assailant. But too often they make their home in a forsaken nest of termites, or in the burrow of some mining beast, such as the aard-vark, and then they are defenceless, the short, trenchant claws of the ratel enabling him to break through the compactest earthworks, and the industrious insects are then at his mercy.

But the peculiar nature of the ratel's skin secures him from the attacks of far more formidable enemies. As a nightly rover and as given to burrowing, he may often come in collision with the deadly serpents of his native country. Now though the snakes of Europe and, according to Charles Waterton, those of South America never take the offensive, those of Africa and India are exceedingly touchy, and are very apt to dart at any intruder who disturbs their meditations. But there is a very trifling probability of a puff-adder, a cobra, or even a hamadryad being able to introduce its venom into the blood of the ratel. What with the thick, compact coating of hair and the looseness of the skin, the poison is expended on non-vital parts. As for scorpions, centipedes, and tarantulas they are to the ratel perfectly harmless. We may here note that when in districts infested with poisonous vermin we wear loose clothing we imitate the defence with which this animal is provided by nature, and if we are foolish enough to range about in viper-covers clad in knickerbockers we deserve what we may possibly get.

From the attacks of wolves, jackals, wild dogs, and leopards the ratel often escapes by burrowing, but if there is not time for this expedient, he falls on his back and defends himself bravely, and often successfully, with teeth and claws. In such cases, again, the thickness and looseness of his skin serves him in good stead, and he is moreover exceedingly tenacious of life.

The ratel is black upon the snout, legs, and all the lower portions of the body, whilst the top of the head, neck, back, and tail are clothed with long, ash-grey hair. This is the same exceptional arrangement of colour which we meet with in the badger, and which has hitherto not met with any explanation. An additional peculiarity is that there runs along each side a bright grey stripe, forming a boundary between the dark and the light-coloured portions of the fur. The ratel in walking applies the entire sole of its foot to the ground, and hence belongs to the *plantigrade* (sole-walking) section of the Carnivora, of which the bears are the type. It displays, indeed, such an analogy to the bears, that it has been called the "honey-bear," a misleading name, since the true bears are all fond of honey. It belongs, however, to the family of the badgers (*Melidæ*).

If taken young, the ratel is capable of domestication, and in captivity it affords much amusement from its grotesque performances. It is exceedingly fond of throwing somersaults, as it is shown in our illustration.

The ratel of South Africa is about a yard in length, of which nine inches go to the tail. It is a very unpopular animal, as horses often tread in its holes and break their legs, or at least throw their riders. In India it is, if anything, still more disliked, from its propensity for digging into newly-made graves to feast upon the bodies. It is thus, in its way, a silent but effective advocate for cremation.

A New Evidence of Organic Evolution.—M. Bordier has recently found among microbia actual instances of transformation. These beings have so brief a life, and multiply with such rapidity, that the observer may witness changes accumulating from generation to generation. During the year there may occur 24,000 generations of bacteria, or as many as could occur in the human race in 600,000 years. One and the same microbion—that of "blue pus"—has been seen under the action of different substances to take the form of a *bacterium*, then that of long filaments, then that of comma-bacilli and that of spirilli.

The Poison of Eels.—From a communication made to the Royal Linceian Academy at Rome (*Cosmos*), it appears that eels and muraenas secrete a venom similar to that of the viper. It is not localised in the mouth, and they are not provided with any organ for instilling it into their enemies. Hence it has no effect upon man, since in cooked eels the poison has been destroyed by the heat applied in cooking. It has further no action unless introduced into the blood.

Prescription for Mosquitoes.—"F. B.," writing in the *Field*, recommends a mixture which he has found efficient in Manitoba and the North-Western Territory. It is made by mixing 1 pint Stockholm tar, 2 pints olive oil, 3 teaspoonfuls Calvert's carbolic acid. The hands, face, and neck are to be anointed with this mixture, when, says "F. B.," no mosquito, sand-fly or "bull-dog" will cause annoyance. He adds:—"The bull-dog seems like a cross between a horse-fly and a hornet." Such a cross, we need scarcely say, cannot be admitted as possible, but we should like to know the real name of this offensive fly. We should also be happy to learn whether "F. B.'s" mixture is better than tincture of *Ledum palustre?*

The Flora of the British Empire.—According to Mr. J. G. Baker, F.R.S., 46,000 species of plants, or nearly half the number existing on the entire globe, grow naturally in the British Empire. One third part of the number belong to India.

Influence of Sewage Farms upon Fish.—A portion of the river Kent, extending for a couple of miles above and below Kendal, and once abounding in trout, is said to have become barren in fish since the establishment of a sewage farm which drains into the river.

Shoals of Fishes.—A marine officer, writing in the *Revue de la Marine Marchande*, states that in 50 degs. N. lat., and 25 degs. W. long. (probably from the meridian of Paris), the steamer in which he travelled sailed for two consecutive hours among fishes; it was night, the weather was fine, and all the fishes had the appearance of sardines. The previous night the same vessel had encountered numerous shoals of fish. According to the estimate of this officer, the shoals covered a space of 700 nautical miles. The point in question was in the full current of the Gulf Stream. The *Bulletin de la Société d'Acclimatation*, suggests that it would be useful to draw up fish-charts, marking the spots where fishes are found in numbers at different seasons, and noting their periodicity or its default.

Organic Poisons.—It is gene ally supposed that all the poisonous principles found in plants contain nitrogen, and are alkaloidal or basic compounds. This is a mistake: two poisonous compounds, which have latterly attracted some attention, strophantine (from *Strophantus hispidus*), and ouabaïne (obtained from the Ouabaio, the arrow-poison of the Somalis), are both free from nitrogen. Both are powerful poisons, acting especially upon the heart. Though not identical they are very similar in composition, strophantine being what is technically called a "higher homologue" of ouabaïne.

The Speed of Carrier Pigeons. — A number of pigeons thrown up experimentally at the Railway Station of Roche-sur-Yon (Vendée) at 5 a.m. reached Beauvais, a distance of 500 kilometres, at 9¾ a m., and had consequently travelled at the rate of 80 kilometres (equal to 50 miles) per hour.—*La Nature.*

Acclimatisation of Wild Turkeys in Europe.—This attempt, which has little interest for the naturalist, has been made with success by Count Breuner on his estate of Graffeneck, in Austria. The three male and four female birds originally introduced have multiplied to a flock of 580 head, in addition to 150 strays which have been shot on adjacent estates. Some of the birds have reached the weight of 19 lbs.

Strange Action of a Beetle.—The other day we saw in a lane near Aylesbury a small beetle (*Platysma niger*) running round in a circle of about 6 inches in diameter. There was no apparent inducement for it to keep in this one track, and no obstacle to prevent it from going elsewhere. After watching the insect for at least ten minutes we left it, still revolving.

An Enemy of Silpha Ophaca.—Like many other of the less formidable agricultural pests, this Silpha, which has turned vegetarian, is being decimated by a parasitical fly, the exact name and nature of which have not been determined, though it is probably a *Tachinus.* At Fournes, ninety-six of the larvae of the Silpha have eggs of this parasite attached to their bodies. Would that some parasite would rid the world of the vine, the coffee, and the potato diseases!

Changes of Colour in Flowers.—The flowers of *Lantana camara,* which are of a deep golden yellow, change before fading into orange and scarlet. *L. nivea* opens white, but turns blue; *L. mixta* is also white on opening, but becomes successively yellow, orange, and red.

Sensitiveness of the Eye to Colours.—The *American Journal of Science* notices the experiments of Mr. E. L. Nichols, on the sensitiveness of the eye for low degrees of saturation of colours. Among his results is that in the male sex the eye is relatively more sensitive to red, yellow, and green, and in the female to blue.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

The fifty-eighth meeting of this Association will be held this year at Bath, commencing on the 5th, and concluding on the 12th of September, under the presidency of Sir Frederick Bramwell, D.C.L., F.R.S., M.Inst.C.E.

It may first be pointed out that Bath has in its geographical position great advantage for such a purpose, and that the railway facilities in connection are fairly good. From London, Bath may be reached in 2¼ hours, from Exeter in 2, from Cardiff in 1½, from Birmingham in 2½, and from Manchester in 5½. The usual cheap-rate arrangements have been made with the various railway companies.

There being no reception room large enough available, the local executive committee is erecting a large temporary building adjoining the Assembly Rooms, where the business of the Association will be transacted. In this, most valuable aid has been and is being ungrudgingly and gratuitously rendered by one of the local secretaries, Mr. J. L. Stothert, M.Inst.C.E., who prepared the plans and is really "engineering" the whole matter.

The first general meeting will be held on Wednesday, 5th September, at 8 p.m. precisely, in the Drill Hall, when Sir Henry Roscoe will resign the chair, and Sir Frederick Bramwell will assume the presidency and deliver an address. On Thursday evening the Mayor of Bath (Anthony Hammond, Esq., J.P.) will give a *soirée* in the Assembly Rooms. On Friday evening Professor W. E. Ayrton will deliver in the Drill Hall a discourse on "The Electrical Transmission of Power." On Monday evening, September 10th, Professor Bonney will give a discourse on "The Foundation Stones of the Earth's Crust." On Tuesday evening there will be a *soirée* of a microscopical and natural history character in the Assembly Rooms; and on Wednesday the concluding general meeting will be held in the council chamber of the Guildhall.

It is anticipated that the Bath meeting will be one of much scientific interest. The eminence of the President, in a profession of great practical importance to the country, would alone attract many visitors. Nor will the names of the Presidents and Vice-Presidents of the sections fail to ensure a good attendance at their meetings.

The sections are the following:—

Mathematical and Physical Science: President, Professor G. F. Fitzgerald, M.A., F.R S.; Vice-Presidents, Captain Abney, R.E., C.B., F.R.S., F.R.A.S., F.C.S., William Esson, M.A., F.R.S., F.R.A.S., F.C.S.

Chemical Science: President, Professor W. A. Tilden, D.Sc., F.R.S., V.P.C.S.; Vice-Presidents, Professor Odling, M.B., F.R S., V.P.C.S., W. H. Perkin, Ph.D., F.R.S., V.P.C.S.

Geology: President, Professor W. Boyd Dawkins, M.A., F.R.S., F.G.S., F.S.A.; Vice-Presidents, W. Whitaker, B.A., F.R.S., F.G.S., Rev. H. H. Winwood, M.A., F.G.S.

Biology: President, W. T. Thiselton-Dyer, C.M.G., M.A., B.Sc., F.R.S., F.L.S.; Vice-Presidents, Professor E. A. Schäfer, F.R.S., P. L. Sclater, M.A., Ph.D. F.R.S., F.L.S., F.G.S., F.R.G.S., Sec. Z.S.

Geography: President, Colonel Sir C. W. Wilson R.E., K.C.B., K.C.M.G., D.C.L., F.R.S., F.R.G.S.; Vice-Presidents, the Right Hon. Lord Aberdare, G.C.B., F.R.S., V.P.R.G.S., E. Delmar Morgan, F.R.G.S.

Economic Science and Statistics: President, the Right Hon. Lord Bramwell, F.R.S., F.S.S.; Vice-Presidents, J. B. Martin, M.A., F.S.S., R. H. Inglis Palgrave, F.R.S., F.S.S.

Mechanical Science: President, W. H. Preece, F.R.S., M.Inst.C.E.; Vice-Presidents, W. Anderson, M.Inst.C.E., W. Shelford, M.Inst.C.E.

Anthropology: President, Lieut.-General Pitt-Rivers, D.C.L., F.R.S., F.G.S., F.S.A.; Vice-Presidents, J. Beddoe, M.D., F.R.S., J. Evans, D.C.L., LL.D., Treas.R.S., F.S.A., F.L.S., F.G.S.

This year there will also be the additional feature of an International Congress of the leading geologists of the world, to whom the unique geological features in the neighbourhood of Bath will be of especial interest; and, further, the first public appearance, so to speak, of Edison's phonograph.

All the chief objects in Bath will be easily accessible. The old Roman bath and its adjuncts, lately uncovered, with other remains, will be of prominent interest; as also the new buildings erected by the Corporation to meet the increasing demand for the Bath waters, and furnished with the newest appliances. The Literary and Scientific Institution, with its reading-room, library, and museum, will all be open. Botanists will be invited to visit the Botanic Garden in the Bath Park, and members generally to see an exhibition of flowers, fruits, and plants, at the Autumn Show of the Bath Horticultural Society.

It is known that the neighbourhood abounds in much that is interesting. On all sides the country is remarkable for variety and beauty. The Somersetshire coal fields and the West of England cloth factories are within easy distance. Bristol and Clifton in one direction; Gloucester and Cheltenham in another; Salisbury, Stonehenge, and Southampton in a third—all present strong attractions. The beautiful cathedral and quaint old city of Wells may be reached by a short journey along the Cheddar Valley.

The following excursions to these and other places have been organised by a special committee,—

On Saturday, September 8th, to Stanton Bury, Stanton Drew, Maes Knoll: Bannerdown, Sodbury Camp, Dyrham, Lansdown: Box Quarries, Corsham, Lacock Abbey: Bradford, Farleigh Castle, Wraxall: Cirencester, Museum and College: Tytherington and Thornbury: Swindon G.W. Works: Berkeley Castle: Wells, *via* Maesbury and Shepton Mallet, Ebbor, Wookey Hole: Barry Docks and Cardiff.

On Thursday, September 13th.—To Stonehenge, Salisbury, Wilton: Silbury, Avebury, Bowood, Wansdyke, Beckhampton: Stourton, Pen Pits, White Sheet, Longleat: Frome Valley, Nunney Whateley: Maesbury, Wells, Glastonbury, Street: Sandford and Banwell, Churchill, Dolbury, Rowberrow, Burrington, the two Charterhouses, Mendip Gorge, Cheddar Cliffs: Severn Tunnel, Chepstow, Tintern, Wyndcliffe: Radstock, Wellow, Littleton.

Another committee is preparing to meet the wants of the members with regard to hotel and lodging accommodation. It is believed that ample accommodation will be found. The Committee will be happy to give any aid in their power to those who may desire it.

The Right Worshipful Anthony Hammond, J.P., Mayor of Bath, invites the members and associates to a *conversazione* in the Assembly Rooms on Thursday, September 6th, at 8.30 p.m.; and the chairman and members of the Local Executive Committee invite the members and associates to a *conversazione* at the Assembly Rooms, on Tuesday, September 11th, at 8.30 p.m. On this occasion the Bath Microscopical Society, assisted by the Bristol Microscopical Society, have arranged for a display of objects in the various departments of natural history, etc.

On Wednesday and Thursday, the 5th and 6th of September, there will be an exhibition of fruits, flowers, etc., in the Sydney Gardens; to this exhibition all members and associates will be admitted on presentation of their tickets. On the 12th and 13th September there will be a horse show.

The places of meetings, etc., are—

In the Assembly Rooms	Reception Room. Conversaziones.
In the Drill Hall . .	President's address. Evening discourses.
In the Guildhall . .	Council meetings. Committee of Recommendations. General Committee. Concluding general meeting.

The Secretaries of the sections will be lodged at the White Lion Hotel.

The following are the section-rooms:—

A, Mathematics, St. James's Hall; B, Chemistry, Friends' Meeting House; C, Geology, Mineral Water Hospital; D, Biology, Mineral Water Hospital; E, Geography, Guildhall; F, Statistics, Christ Church Hall; G, Mechanics, Masonic Hall; H, Anthropology, Grammar School; Sub-sections C, and D, Blue-coat School.

The reception-room at Bath will be opened on Monday, September 3rd, at 1 p.m., and on the following days at 8 a.m., for the issue of tickets to members, associates, and ladies, and for supplying lists and prices of lodgings, and other information, to strangers on their arrival. In the reception-room there will be offices for supplying information regarding the proceedings of the meeting. The published volumes of the British Association can be ordered in this room, for members and associates only, at the reduced prices appointed by the Council. The tickets will contain a map of Bath, and particulars as to the rooms appointed for Sectional and other meetings. For the convenience of members and associates a branch post and telegraph office (which will be available also for communication between members attending the meeting) will be opened in the reception room.

By the courtesy and liberality of the Directors of the Western Counties and South Wales Telephone Company, the whole of the section-rooms will be telephonically connected with the reception-room and, through the Telephone Exchange, with all important places in the neighbourhood, free of any expense to the Local Executive Committee, or members and associates, for the meeting.

THE COLUMBUS COMMEMORATION.—On account of the four hundred years' anniversary of the discovery of America, to be celebrated in 1892, the Italian Government, as we learn from *Cosmos*, has decided to publish all documents and maps relating to Columbus. The execution of this project is committed to the Senator Correnti, with the assistance of a commission of *savants*.

THE ZOOLOGY OF THE BATH DISTRICT.—II.

(Concluded from p. 134.)

THE list of local reptiles is necessarily a very short one, the whole number of British species, including the amphibia, being only twelve; of them the Bath district yields nine species. Mr. Charles Terry mentions ten species, but one of these, the sand-lizard (*Lacerta agilis*), is evidently an error. The viviparous lizard (*Zootoca vivipara*) and the blind-worm, or slow-worm (*Anguis fragilis*), are both common in suitable localities.

The common or grass snake (*Tropidonotus natrix*) is rather scarce; much more so than its dangerous relative the viper or adder (*Pelias berus*); a fine specimen of the latter may be seen in the Duncan collection.

Of the Amphibia, the toad (*Bufo vulgaris*) and the frog (*Rana temporaria*) are both very common. The crested newt (*Triton cristatus*) and the smooth newt (*Lissotriton punctatus*) also are abundant. The palmated newt (*Lissotriton palmipes*), marked as "rare" in Mr. Terry's list, is very abundant in some localities. This species seems to have become much commoner of late years, in many ponds even exceeding the smooth newt in numbers.

Of the Fishes Mr. Terry enumerates fifteen species curiously enough omitting the perch (*Perca fluviatilis*) and the carp (*Cyprinus carpio*), both of which are plentiful in the Avon and canal. There are two distinct species of eels; the sharp-nosed eel (*Anguilla acutirostris*), which is sometimes taken at the weirs in immense numbers; and the broad-nosed eel (*Anguilla latirostris*) which seems more resident in the Avon, not migrating *en masse* like the former species.

A somewhat local species is the bearded loach (*Cobitis barbatula*), to be found hiding under stones in some of the small streams which flow into the Avon. The flounder or dab (*Platessa flessus*) comes up the Avon as far as Bath, which seems to be its limit, as it is not found above. Of the sticklebacks, only one species is recorded—the smooth-tailed stickleback (*Gasterosteus leiurus*), which swarms in brooks and ditches. Careful study of these fishes should yield one or two more species. For the present the total number of species of fish recorded in the district is eighteen.

Turning to the Invertebrata, of the Mollusca the neighbourhood of Bath yields a good number of species; the Avon and canal contain most of the aquatic species, and of those which live on the land, "Helices," "Bulimi," etc., there is also a long list. Dr. Bird, in Vol. I. of the Proceedings of the Bath Natural History and Antiquarian Field Club, gives a list of sixty-five species of local mollusca. The subject has been more fully treated still by Mr. J. E. Daniel in his paper on the mollusca of Bath, read before the Zoological section of the British Association in 1864, *vide* report of last meeting at Bath. Mr. Daniel enumerates ninety species, belonging to twenty-eight genera. Attention is also drawn in the same paper to the parasites of Anodonta; as these shells abound in the canal they afford ample material for the study of those curious Entozoa. The Duncan Museum also contains a very nice collection of local shells, among which the specimens of "Anodon Anatina" are remarkable for size and beauty. There are also specimens of that curious slug *Testacella maugei* from Batheaston and Bitton.

Turning, lastly, to the most popular branch of natural history, namely, entomology, a science that owes its popularity to the extreme beauty of some species, and to the facility with which specimens may be captured and kept for future observation; and lastly, also, to the enormous number of species which it contains, 200,000 species being known, and this (according to Dr. Sharp) is not more than one-tenth of the number actually existing. What a field for research? That venerable local scientist, the Rev. Leonard Blomefield, without a reference to whose labours for the past 30 years in the study of local phenomena no sketch of the natural history of Bath would be complete has drawn attention to the fact of the comparative scarcity of insect life in the district, as compared with other districts in the Eastern counties. Mr. A. E. Hudd, also, in his carefully worked out list of the *Lepidoptera* of the Bristol district, says, "Collecting in this district is disappointing to those accustomed to other parts of England;" that is, in the number of good things that would fall to any one seeking local rarities. Mr. Terry gives a list of 541 species of *Lepidoptera* for a radius of six miles around Bath, but his list is evidently imperfect, and there seems no reason why the number of species should not be much nearer to the number recorded for the adjoining district of Bristol, by Mr. Hudd, viz., 1,310. Some of the species enumerated by Mr. Terry have quite vanished from the district, such as *Papilio machaon, Colias hyale, Pieris daplidice,* and *Limenitis sibylla. Apatura iris,* that "blue ribbon" of the lepidopterist, has been seen several times. *Lycœna Adonis* has not been found nearer than Bristol. *Lycœna Acis,* though very rare, has occurred near Bath, and also the beautiful *Lycœna arion* has been recorded from "Hills near Bath." Of the *Nocturni,* the following are some of the most noteworthy: *Chaerocampa elpenor,* one specimen taken at Sugar, by Mr. J. G. Ross, near Bath; *Arctia fuliginosa,* same recorder, from Bathampton. The following scarce *Geometrœ* have also been recorded by Mr. Ross: *Emomos tiliaria* and *E. fuscantaria, Ephyra trilinearia, Lobophora lobulata, Scotosia certata,* etc. The unique *Platypteryx sicula* has not been recorded nearer than Leigh Woods, near Bristol. Many rarities have been reported from near Bath, such as *Neuria saponaria, Rusina tenebrosa, Cerastis erythrocephala, Euperia fulvago.* That grand insect *Catocala fraxini,* is recorded from Leigh Woods, near Bristol, in 1880; and the rare *Aventia flexula,* from near Bath, by Mr. Ross. It is to be hoped that the members of the Bath Natural History and Antiquarian Field Club will thoroughly work out their local *Lepidoptera,* and also the much-neglected *Coleoptera,* and other branches of entomology, such as *Neuroptera, Diptera,* etc. An excellent paper, on the *Hemiptera-Heteroptera* of the district will be found in the proceedings of this Society, vol. vi., No. 3, by Lieut.-Colonel Blathwayt, F.L.S., F.E.S.; over 40 species are there referred to.

Many other branches of natural history have not yet found exponents among local students; for instance, the *Arachnida,* which would doubtless afford material for as substantial a monument of industry as the Rev. O. P. Cambridge's splendid monograph of the "Spiders of Dorset." The curious little *Cheliferœ,* or pseudo-scorpions, are not uncommon under dead leaves, or beneath bushes and hedges. Those singular worms, the *Land Planaria* were found by Dr. Bird under stones and rotten wood, in woods on Lansdowne. This rapid and imperfect sketch of the zoology of Bath cannot be concluded better than by these words of the Rev. Leonard Blomefield:—

"There is enough in any one of these inquiries to employ the leisure hours of a man's life if he will give his mind to it. Results of value, however, can only be obtained after many years of close observation, carried on for the most part in the same locality."

EXTINCT BRITISH BUTTERFLIES,

And the Continuity of Existing Species by Means of Migration Considered.

(*Continued from p.* 125.)

A FEW years ago the common large white butterfly (*Pieris brassicæ*) became remarkably scarce throughout the country, so that entomologists were afraid that it had followed in the wake of the black-veined white (*Aporia cratægi*). In the summer of 1884, however (as recorded in the *Entomologist*), our gardens were visited by an innumerable horde of this species, and since then it has occurred in tolerable abundance in every locality we have visited. Whether the continuity of this species was maintained by migration from the continent, we are not in a position at present to determine.

Now migration possesses a far wider influence upon the present distribution of the *Rhopalocera* in the British Isles than is generally entertained. Many species would undoubtedly die off in the course of a very few years if it were not for the continual stream pouring over here from the continent to take the place of those species which succumb to the adverse influences of our climate. Let us take the Painted Lady Butterfly (*Vanessa cardui*) as a good instance.

This insect possesses a wide area of distribution, being found in nearly every country in the globe. It is one of those insects in which a strong migratory instinct appears to be developed. Gathering together in enormous clouds, they quit the place of their birth, and depart in search of "fresh fields and pastures new."

The Painted Lady produces two broods in the year, and hibernates in the perfect state. When one of these large migratory hordes reaches this country, it generally appears to be composed of those insects that have hibernated; such hordes reach our shores in or about June.

If the swarm is a large one, the butterflies spread over the island; if, on the other hand, the swarm is a small one, the range is more restricted. The butterflies then breed and die. The first brood is produced in August, when the imagines again in their turn deposit ova on the thistles and die. In our British climate thistles and kindred plants die early in the autumn, and before the *larvæ* can feed on them the chilly nights have withered the food plants. Starved with cold and hunger, the *larvæ* fall victims to our climate, so that the second brood, which ought to live over the winter to continue the race over another year, never reaches maturity, and the species disappears.

It may happen, however, sometimes that a few of the first brood emerge so late that they hibernate or emerge so early that the progeny passes through the various stages and does the same. Either of these occurrences would carry the race on for another season, but it does not seem possible for this to last more than a year or two. The species is then lost until a fresh migration causes it to be abundant once more.

The year 1879 will long be remembered for the great numbers of this butterfly which were seen in this country. It occurred all over the British Isles, as far north even as the Orkneys and the Shetlands. Since that date, however, it has not been seen in abundance in any locality known to us.

Several species of butterflies which occur in this country are *entirely* dependent on migration for their appearance. These are the Bath white (*Pieris daplidice*), the two clouded yellows (*Colias hyale* and *C. edusa*), the queen of Spain fritillary (*Argynnis lathonia*), the Camberwell beauty (*Vanessa antiopa*), the pea-pod Argus (*Lampides boetica*), and the great American butterfly (*Danais archippus*).

In the case of *Vanessa antiopa* it was formerly believed that the fact of all the specimens taken in this country possessing white borders to their wings, while those on the Continent have yellow borders, was sufficient proof that the former were indigenous to the British Isles. Subsequent investigation and observation, however, have proved beyond doubt that those insects with white borders to their wings are old specimens, being generally those which have hibernated. They moreover also occur on the Continent in spring, whereas it was thought that they were peculiar to this country. In our opinion, therefore, the occasional appearances of this grand insect in the British Isles may be referable to the same theory of continuity by migration as in the case of *Vanessa cardui*.

The two clouded yellow butterflies (*Colias edusa* and *C. hyale*) have both a great predilection for wandering, and on account of the number which have of late years made their way over from the Continent both species seem to be apparently becoming more plentiful and widening their area of distribution in the British Islands. About fifty years ago both these insects were looked upon as great rarities. They are now however, to be met with somewhere in the country every season.

The year 1877 will long be remembered as the great "Colias year," when they occurred in this country in immense swarms.

Their increase may be attributed in some measure to the same cause which is operating just the reverse with such a number of other species, namely, cultivation—the extended cultivation of various tracts of clover by agriculturists, this plant constituting the pabulum of both species.

In this country *Colias edusa* occurs much more commonly than *C. hyale*, the reverse being singularly the case on the Continent.

Danais archippus is a species which has the last few years occurred in this country in considerable numbers —chiefly on the south coast. It is decidedly cosmopolitan in its distribution, being found over a great part of the globe. In America it is found from the Arctic Circle to the Tropic of Capricorn. Its occurrence in our own country is due, of course, to migration. It is a species that possesses a very powerful flight and is capable of withstanding great vicissitudes of climate, and in addition two species of plants, *Vinca major* and *V. minor*, very closely allied to one of its *pabula*, occur abundantly on rocky places in the south of England; so that it is not at all unlikely to establish itself over here at some future date, as it has already done in Australia and New Zealand, etc.

(To be continued.)

Injurious Action of Noise.—Dr. W. B. Platt *(Popular Science Monthly)* formally recognises noise as one of the chief injurious influences of city life, and makes suggestions for its limitation, such as the abolition of church bells.

Reviews.

Alkali Works Regulation Act, 1881. *Twenty-fourth Annual Report on Alkali, etc., Works, by the Chief Inspector. Proceedings during the year* 1887, *presented to the Local Government Board and to the Secretary for Scotland.* (London : Printed for Her Majesty's Stationery Office.)

There still exist educated and intelligent persons not a few to whom the nature and the necessity for the so-called *Alkali Act* are perfectly unknown. The case is this : in the manufacture of alkali from common salt by the Leblanc process, the salt is converted into sulphate of soda, or salt-cake, by heating with sulphuric acid. During this process all the chlorine of the salt, which is more than half its entire weight, is given off in the state of hydrochloric acid gas. In the earlier days of this important manufacture this acid was allowed to escape freely into the atmosphere, when it became the cause of abundant mischief to all kinds of vegetation in the districts. An Act was therefore passed, compelling manufacturers of alkali to condense the acid vapours given off. Similar enactments were made to control the escape of other acid and corrosive fumes, and the working of this Act was placed in the hands of a Chief Inspector and a number of assistants. It was feared at first that this legislative interference would gravely compromise the position of an industry of great national importance. But, thanks to the scientific resources, the practical judgment and the tact of the first Inspector, the late Dr. R. Angus Smith, the end desired—the protection of the public—was attained without any injury to the trade. It may even be said that the vapours which were once simply a nuisance have now become the main source of profit of the alkali manufacturer.

The total number of works registered under the Act was, in 1887, in England and Ireland 927, and in Scotland 198.

It is a very gratifying feature, brought out in the report before us, that the escape of acid gases is considerably less than what the law stipulates. Thus the maximum amount of hydrochloric acid tolerated by the Act is one-fifth of a grain per cubic foot of chimney-gases. The quantity actually escaping is only half that limit. The escape of sulphurous acid from the lead chambers is very little more than one-third of the limit laid down. An additional ground for congratulation is the fact that this improvement has been effected not by a system of prosecutions, but by an investigation of the causes of any irregularity complained of and by suggestions as to its removal. Only four prosecutions under the Act have taken place during the year, three of them for neglecting to register works liable to inspection under the Act, and the fourth at a manure-works, for neglecting to use the best practicable means of arresting noxious gases.

The report duly notices the struggle now taking place between the process of Leblanc and the so-called ammonia-soda process of Solvay. About three millions of money are supposed to be invested in the Leblanc process in this country, which will be to a great extent wasted if that process has to be abandoned.

The total quantity of salt used in the United Kingdom in the Leblanc process is 649,867 tons yearly, whilst 158,636 tons are consumed in the ammonia-soda process.

A fearful nuisance connected with the Leblanc process is the production of so-called "vat-waste," a material which on contact with any acid, even the carbonic acid of the atmosphere, gives off sulphuretted hydrogen, whilst an offensive liquid drains away from the mounds of this refuse, often finding its way into water-courses.

Of this offensive material there are now 1,500,000 tons produced annually. At Widnes, in Lancashire, these deposits cover 450 acres of ground, and contain above 8,000,000 tons, to which 1,000 tons are added daily. Such being the condition of things, it is very satisfactory to learn that two processes are being elaborated, each of which bids fair to extract the sulphur from these mounds, thus rendering what is now a nuisance to all parties, harmless to the public and profitable to the manufacturer.

The present Chief Inspector, Mr. Fletcher, points out a number of inconsistencies in the provisions of the Act. Thus any escape during the manufacture of sulphuric, nitric, or hydrochloric acid (above the proportion legally fixed) renders the proprietors liable to a penalty. But an escape of these acids to any extent whilst being used—not made—falls outside the provisions of the Act, and the inspector cannot interfere. But suppose the manufacturer, in order to abate the nuisance, attempts to condense the fumes, he then becomes a "maker" of the respective acid concerned; the works must be duly inspected, and if the method of condensation adopted is insufficient, he is liable to prosecution.

It appears that the production of sulphurous acid is regulated by the Act only when it is generated in order to be ultimately converted into sulphuric acid. If it is made for any other purpose, or with any other result, it is exempt from inspection. Thus the production of acid fumes from the combustion of fuel rich in sulphur is the cause of a frightful nuisance, but it completely escapes control. The inspectors, therefore, suggest that the present Alkali Act should be superseded by a general Noxious Vapours' Act—a very desirable step.

Model Engine-making. By J. Pocock. London : Swan Sonnenschein, and Co.

A book intended to help ingenious boys to make unmechanical model steam-engines with the least possible apparatus. We confess to a horror of those hissing little monstrosities called "model" steam-engines ; the manufacture of them serves no useful purpose, unless it be to keep idle hands from mischief, as their educational effect on the manufacturer must be *nil*, the builder's efforts appearing to be chiefly directed towards making something as unlike any engine that was ever made, since the days of Newcomen and Trevithick, as possible.

The model engines illustrated and described in this little book are just what amateurs have kept on making for the last thirty years, neither better nor worse, faulty in construction, crude in design, and "sloppy" in workmanship.

Cannot the amateur be instructed how to make something a little more modern than oscillating cylinder locomotives and table-engines ?

The Navigable Balloon in War and Peace. By General W. N. Hutchinson. Eastbourne : Farncombe and Co.

There exists a very general belief that every invention, if only practicable and successful, should be greeted as a boon without sufficient regard to the character of its possible results. This belief will, on careful consideration be found to be a grave mistake. There are, of course, inventions—it would be invidious to point out instances—which are unmixed benefits to mankind.

There are others, such as the lucifer match, where the good does little more than turn the scale; and there are, lastly, a class where the apparent evil results are likely to counterbalance, if not to overbalance the good.

It is a strange and painful fact that in the present day the attention of inventors is more than ever turned to devices for the wholesale destruction of human life and of property. This is obviously a subject so largely mixed up with moral and political considerations as to fall very barely within our legitimate scope. But we may point out that recognised governments may, perhaps, refrain from the employment in war of "high" explosives, of aerostats, submarine boats, etc.; but will treasonable societies be so scrupulous? We fear not. It is, indeed, noteworthy that the chief use of the "high" explosives hitherto made for the destruction of human life has been in the so-called "private war" waged by such bodies against governments.

It must also be considered that the "navigable balloon" will be of immense advantage to the ordinary criminal. He can come in the night, sailing unseen over the heads of policemen or soldiers, and break into banks, warehouses, mansions, etc., at upper windows or skylights. In the morning no trace of him will be left, and there will be no clue to suspect any one of the inhabitants of the globe more than any other. For murder or other outrage the facilities will be as much increased as for robbery.

Hitherto, and especially of late, the criminal classes have shown themselves fully alive to any inventions which promise to subserve their objects. Why, then, should they hesitate to use the "navigable balloon"?

Of course the utter proscription of such inventions would be practicable only if all nations would agree. But, unless we are wrongly informed, the Austrian Government has shown a good example by suppressing an invention which would doubtless have been useful to its possessors in war, which would have given man complete safety in dealing with wild beasts, but which would have opened the door for robbery and murder on the vastest scale.

Geology for All. By J. Logan Lobley, F.G.S. London: Roper and Drowley, 29, Ludgate Hill.

This little book contains the substance of a course of lectures delivered at the City of London College in 1887, which appeared in a series of articles written for the *Industrial Review* by the author.

It was a happy thought to have these articles republished in book form, as they make a concise introduction to the study of geology as a science, and can be recommended to any one who desires to gain a general knowledge of the composition and classification of the rocks forming the earth's crust, without taking the science of geology as a regular study.

We think that the author has been very successful in writing a small, comprehensive book on geology that is interesting and attractive to those requiring only a general knowledge of the subject, and at the same time has produced a work that will serve as a good introduction to a more complete study of the science.

Causes of Mental Phenomena. — According to an American contemporary, Dr. S. V. Clevenger is endeavouring to work out the proposition that "mental phenomena are modes of chemical energy."

BRITISH MEDICAL ASSOCIATION.

Abstract of the Presidential Address by William T. Gairdner, M.D., LL.D.

In seeking about for a topic on which I might occupy your attention this evening, I have been led to make some special reflections on the curious survival among us of an ancient way of thinking that is presented to the mind by the designation in English of the *physician*, or, as Chaucer has it in his well-known Prologue to the "Canterbury Tales," the "Doctour of Physike." I do not know if it has occurred to many of you to observe that in no other language than our own has this survival occurred. The surgeon—*chirurgus*—has, indeed, kept from a very remote antiquity the title which was given to him in the days of his subjection as the *handworker* or *operator* under the direction of the physician. But the most remarkable thing about this last, and conventionally the higher, title is that while it seems to recall a time when the medical art was distinctively associated in the minds of men with the study of φύσις, and when the healer of the sick was regarded as in a very special, if not exclusive sense, a *student of nature*, it is very hard to discover from the traditions of language, either our own or any other, when this idea first took shape—how and when the notion began to be entertained that the most fitting title for the most highly honoured representative of the medical art was to call him, distinctively, a *naturalist*, or, if you will, a natural philosopher or *physicist*. It has occurred to me that it may not be an altogether unprofitable task for one who holds a chair in this University popularly designated as one of *Physic*, to inquire how the idea represented in this word *physic* came first into existence, and how it got floated into such a degree of popularity as not only to have practically displaced to a considerable extent in our own language the much older one of *medicine*—that is, healing—as applied to the art itself, but to have got itself into currency as applied to the very tools of the art, the drugs with which the physician, so called, was supposed mainly to work his cures. I hope to be able to show you that these words *physician* and *physic* have relations with some of the very best and highest traditions of antiquity, and that it may be possible for us even now to make an application of them which will repay and at the same time justify their retention in the English language, although, it may be, tending also to discover certain deficiencies which still unhappily exist in our systems, both of medical and general education.

My argument, in other words, will be this:—For a series of indeterminable ages, from the time, very probably, of Hippocrates downwards to what we call the dark or middle ages, the tradition has continuously existed that the healer or physician of the highest class ought also to be, in a very real sense of the word, a naturalist or perhaps a man of science (physical science being, of course, understood); that it is his prerogative to be trained and exercised after the best manner and according to the most thorough discipline of the science of his age; and that he ought to be (or, at least, that he has been in very remote times) regarded as being admirable and trustworthy as a healer or physician chiefly in proportion to the confidence reposed in him as a naturalist, that is, a humble, reverent, and exact follower and student of nature.

You are all familiar, no doubt, with the magnificent opening of the "Novum Organum,"* which ascribes to man as the "minister (or servant) and interpreter of Nature" only so much either of power or of knowledge as he has gained by observing the order of nature, outside of which he neither knows nor can do anything. Now, it is a curious fact, which has not escaped the editors of Bacon in recent times,† but which may require, nevertheless, to be brought to your notice, that the very word or phrase here used to designate the limitations imposed upon the *power* of man in reference to Nature is the one which, in a very remote age, had suggested itself to Hippocrates as specially indicating the function of the healer. He is, he must be (according to Hippocrates), "the servant of Nature"—ὑπηρέτης φύσεως. Nor is this a mere accidental expression, which might be passed over as a coincidence not extending below the surface. On the contrary, the expression is taken up and specially commended by Galen (surely the best of all authorities on such a point) as being of the very essence—the key-note, as it were—of the Hippocratic teaching, with which all the later authorities (Aristotle and the Peripatetics), as he tells us, were essentially in accord.

But to return to Hippocrates and his remarkable declaration, that the ἰάτρος, or healer, is the servant of Nature (φύσις). This expression, as I have already said, is no merely casual one in the writings of Hippocrates; for Galen remarks upon it, and (in the full knowledge, therefore, of all that could be said for or against the expression by rival sectaries) he does not hesitate to declare that Hippocrates was "*the first* to observe the works of Nature:" and that he "is always admiring and insisting upon the sufficiency of Nature, whereby what is necessary for the life of all animals is done ἀδίδακτος—that is, spontaneously, and without apparently conscious effort." He thus places Hippocrates distinctly in advance of, if not above, Aristotle and the Peripatetics, in respect of originality in the study of φύσις; and he further maintains that Erasistratus, the Alexandrian anatomist, had adopted an inconsistent attitude towards Nature, and that his followers had exposed themselves to ridicule by their unintelligent criticism on what was simply a development by the Peritetics of the physiology—that is, Nature-teaching—of Hippocrates. It is not necessary to go into this old controversy now further than to show that, by the very fact of its having become a controversy at all, the position of the ἰάτρος, or healer, as the "servant of Nature," must have been very well known not only to Galen, but probably also to Aristotle: and through these to the Arabian physicians and to the whole of the middle ages, of which they were the teachers and lawgivers.

Nor did Hippocrates, the father of medicine, escape the reproach which it has been so easy and so profitable in many ways to fling at those who, in a later day, have proceeded in accordance with his precept, if not his example. We hear chiefly from Pliny and Cælius Aurelianus of a certain Asclepiades of Bithynia, a contemporary of Cicero, whose true character it seems rather difficult to decipher, but who at least may be said to have been a fashionable physician in Rome, with a brand-new system of his own. Asclepiades, whose *rôle* in the treatment of disease seems to have been one of constant interference, or, as we should say, of meddlesome physic, only (it is believed) using as a rule and in a temporising kind of way, the mildest and most agreeable of medicines,* had, of course, no appreciation at all of anyone who, in his character of a healer, professed to be a "servant of Nature." He said, in fact, that, in speaking of nature as a kind of intelligent principle, Hippocrates was (not to put too fine a point upon it) talking nonsense. Nature is too often bent, not upon healing the man, but (as a witty member of this Association once said in my hearing) on putting him into his coffin! Hippocrates, as the servant of Nature, is simply a *waiter upon death* (θανάτου μελέτην). The true business of a physician is to "make himself master of the occasion"—that is, to shove old Dame Nature out of the way, perform the cure *tuto, cito, et jucunde,* and claim all the credit, which, no doubt, he did in Rome, as the quacks in all ages have done everywhere, with great comfort and advantage to himself, and (let us hope) with the minimum of injury to his patients.

The truth and the falsehood that underlie this old-world argument I will not attempt to discuss this evening, having done so already on more than one occasion. I am alluding to it now mainly to show that the position of him whom we now call the physician, in reference to φύσις, was a well-recognised one long before the origin of the term *physicus,* as applied to him in the Latin of the Middle Ages and the French of the thirteenth century—from which, in all probability, we have derived our English word. What I have now to do is to inquire how far we are maintaining, in this nineteenth century of ours, the position assigned to Hippocrates by Galen (and, I have no doubt, rightly assigned) of being prominent among the seekers into φύσις, or, at all events, capable workers in this field, in accordance with the methods and advances of modern physical science.

It may be not unimportant for this purpose to remark that, so far as we can judge of him from literature, the physician of the middle ages, though retaining the name, was in a very small degree, if at all, cultivated according to the type. Chaucer's Doctour of Physike, though very far indeed from being a pedant, was assuredly much more of a *learned* than of a *scientific* physician. The fate of Roger Bacon in the century before Chaucer was an amply sufficient warning to the good-natured and easy-going doctors of his time that anything like original research into φύσις was dangerous—nay, liable to be proscribed and punished with imprisonment, perhaps with the faggot, unless it proceeded exactly on the lines of St. Thomas Aquinas, the "angelic doctor." It was very much easier and more comfortable, in every way, to stick to Hippocrates and his "humours," where everything was sure and safe; and to add a little astrology, which at least was permitted, if not encouraged,† and

* "Homo, Naturæ minister et interpres, tantum facit et intelligit quantum de Naturæ ordine re vel mente observaverit, nec amplius scit aut potest."—Aph. i.

† See note at p. 157 of Ellis and Spedding's edition of Lord Bacon's works, vol. i., 1870.

* He is reported to have been the inventor of the phrase, "Tuto, cito, et jucunde," as applied to medical treatment in general. But he also employed, according to Pliny, magical remedies to a great extent. (See Le Clerc: Histoire de la Médecine, 2nd partie, l. 3, cc. 4-7.)

† Judicial astrology, however, which (according to Naudé) was "l'enfant supposé de l'astronomie," was (he says) very properly condemned by the Church, "non point comme suspect de magie, mais comme une science vaine et chimérique, *quæ stellis ea quæ geruntur in terrâ consecret;* qui veut pénétrer dans nos destinées, et qui par la témérité qu'elle a de vouloir s'égaler à la Providence, en fouillant dans l'avenir, combat directement la religion." So that Chaucer's Doctour of Physike was, perhaps, a heretic after all!

could get no one into trouble. And when we come down more than a century and a half to Rabelais, two centuries to Montaigne, three centuries to Molière and Guy Patin, we find the position still much the same, or rather, in all probability, worse as respects the *physician*, although surgery and anatomy may have been making some steps in advance. I apprehend that the doctor of medicine in the middle of the seventeenth century in France, unless he has been caricatured out of all recognition by Molière, must have been altogether the most stupid, pompous, brainless formalist that ever in any age of the world practised the art under a learned title. The satirical portrait of Thomas Diafoirus, and the magnificent installation of Argan in the "Malade Imaginaire," remain for us and for our remotest successors, to show how the art of healing may degenerate under the influence of scholasticism, and how base a creature it was at least *possible* to represent a "physician" as having become in the days of Louis XIV., in the midst of a most brilliant outburst of literature and art, at the very time when Harvey's great discovery was slowly making its way against prejudices derived from the darkest of the middle ages, and the still overpowering authority of Aristotle and of Galen.

But at this time the Faculty of Medicine in Paris was probably the last retreat of obscurantism in all Europe, at least within the domain of the physician. In Italy, in England, in Switzerland, in Germany, and in the Low Countries, the spirit of observation and experiment was awakening from a long sleep; and in many departments —anatomy, botany, physiology, surgery—things were moving on apace; but the physician was almost everywhere belated in the race. Even down to the last century, the man of *learning* (of the type of Linacre and Caius) in the Royal College of Physicians of London greatly predominated over the man of *science*, as exemplified in William Harvey; while Oxford and Cambridge, which alone could open the portals of the College, were absolutely *nowhere* as schools either of science or of medicine; and neither taught, nor professed to teach, anything but a mostly mediæval curriculum. And thus it came about, so late even as the year 1815, that the curious anomaly of the "double qualification" obtained a legislative sanction in English medical education. For, while in most European countries, the State and the universities co-operated in arranging and controlling the issue of a single qualifying diploma for the general practitioner, the Royal College of Physicians of London was still too much the college of a learned *caste* to allow of their exclusive privileges being shared by any but university graduates; while the two great English universities were altogether too helpless, as regards the necessary discipline of a medical career, to make it even possible for them to afford the slightest assistance. The Royal College of Surgeons, on the other hand, which had for ages concerned itself only with anatomy and surgery, to the exclusion of physic, continued on the even tenour of its way, including in its membership men ignorant of Latin, but instructed as regards fractures, dislocations, and surgical procedures generally; while the Worshipful Company of Apothecaries, cleverly perceiving and taking advantage of the enormous gap which was at once apparent between the technical discipline of the pure surgeon and that required for the all-round practice of the medical profession, marched into a position of legal independence through this gap, and, from being the humble servants of the physician, obtained for their licentiates not only the exclusive right to dispense medicines, but the status of prescribing them also, and thus a perfectly just and well-earned rivalry with the physician all over England.

What I am chiefly concerned to bring under your attention, however, in this connexion is that, according to the historical development, or evolution, of medical education in this country, and especially in England, the physician, in the sense of *Naturæ studiosus*, the devotee of φύσις, as aforesaid, stood a very fair chance of being altogether, and finally, suppressed and wiped out of existence.

From the earliest days of my experience as a teacher it has been customary with me to use expressions and to act in a spirit, of which you may readily judge for yourselves from the following brief paragraph, taken from an address to students of medicine, delivered more than twenty years ago: "The first lesson to be learned in order to make all other lessons possible is, in my opinion, this—to deal very largely with things and not with mere words; to realise as much as you can all your instruction by making it your own through personal observation; to suffer nothing, if it can possibly be avoided, to lie in the mind as a dead weight of vocables, oppressing the memory and dwarfing the intellect; but to bring everything into the living light of fact and of nature, and thereby at once to assure to yourself the truth and exactness of your knowledge, while at the same time you are stamping it down upon the memory by the most sure and lasting of all technical methods." *

No one can be more ready than I am to admit that there are—nay, that there must be—limitations in the very nature of the case to the too absolute recognition of this ideal. It is said by some that the spirit of modern science is ungenial and hard, even pitiless, and therefore not at all fitted for the ministrations of humanity; that it tends to make the suffering man, the *patient* (as we call him), into a mere case—a thing to be observed and noted rather than a man of like passions with ourselves, and therefore to be treated with consideration and sympathy. There may be just a grain of truth in this; and to whatever extent it is true, we of this medical school claim to be aware of the fact, and to be ever on our guard against the tendency. But none the less it may be affirmed with entire truth, and with cumulative evidence if need be, that all the evils inflicted on poor suffering humanity by the physician as scientist have been but a drop in the bucket as compared with those which have sprung from the too slavish adoption of traditions, in which there never was any trace of the scientific spirit at all.

I shall venture to anticipate—because I am well assured that anything I can say here will only give expression to what will still more clearly emerge from the forthcoming address in physiology by my esteemed colleague Professor McKendrick—some of the discouragements to which I referred a moment ago, the difficulties we experience in training our students adequately on the lines we have laid down from them. These difficulties are manifold, and they are not of our making, nor are they peculiar to Scotland. I have only time now to refer to two of them.

The first of these difficulties belongs to the medical curriculum, in which, although chemistry, botany, and natural history have long been with us a necessary part, and, so far as they go, a well-conceived and valuable scientific basis for the more technical part of our teaching, nevertheless physics proper—or, as we call it

* "Medical Education, Character and Conduct," etc., p. 70.

natural philosophy—the very first step in the study of the laws of matter, is still but very imperfectly recognised. This great omission has arisen, no doubt, from the fact that these laws were supposed to be taught, and in a measure were taught, in connection with chemistry, which, from its old hereditary relations with pharmacy and the pursuit of the philosopher's stone and the elixir of life, had from time immemorial a claim on the physician. But when we consider how completely modern science has demonstrated the subordination of living bodies and physiological processes, not to a wholly detached set of laws termed vital, but to all the most elementary laws of matter; and, further, the correlation of all the physical forces throughout the universe, so that the living body and its environment act and react on each other throughout infinite space and time, it will be readily admitted, I think, that some kind of systematised instruction in physics, and not a mere elementary examination in mechanics, should be an essential part of an education with a view to the medical profession.

But this leads me directly to the other difficulty, or disadvantage, under which the Scottish universities have hitherto laboured in endeavouring to restore to the healing art its ancient association with the study of Nature. And this is by far the graver difficulty of the two, inasmuch as its rectification depends in no degree upon us or upon any possible change in the medical curriculum, but upon what amounts to a practical readjustment of the entire edifice of general education.

The evil to which I now refer, as some of you have already no doubt perceived, is the extremely unprepared state in which the minds of most boys and young men are found at the time of their leaving school as regards the most elementary truths and methods of physical science, and of the observation of Nature. It is now more than a quarter of a century since this great defect in the English public schools attracted the attention of a Royal Commission appointed in 1861, and there is no reason to suppose that in Scotland, at the time in question, the state of school education was in this respect much better than in England. Evidence of the most convincing kind was given in 1872 before another Royal Commission to the effect that "the limitation of the examinations (under this revised code) to the subjects of reading, writing, and arithmetic unfortunately narrowed the instruction given in the elementary schools; and that this change, together with the lower standard adopted in the training and examination of pupil teachers and the curtailment of the syllabus of the training colleges, exercised a prejudicial effect on the education of the country." I am well aware, indeed, that in Scotland, and even in our own city of Glasgow, there are schools which have already made some considerable advances in the direction here indicated, and that in the old High School of Glasgow, in particular there exists now a chemical laboratory such as would do no discredit to any university. But as regards the schools throughout the country, the advance has been so slow that for a long time to come our boys will leave their schools, and our young men will continue to enter the universities, in a state of great mental unfitness to grasp even the most elementary ideas of physical science, and therefore requiring more than ordinary care to ensure, at the very commencemeut of a medical education, the preparation in *physics* which will shortly become all-in-all to the true *physician*.

I have now to ask your attention, for a very few minutes only, to a concluding topic, which I approach, indeed, not without fear and trembling, but which is of too much prominence and importance in itself, in connexion with the subject of this address, to allow of my passing it by without some reference.

Probably there may be some of you here present who have been led to take note of a proverb, which I am bound to say I have not been able to trace to its source, but which I suspect to have been the growth of that mediæval period to which allusion has already been made in the course of this address: "Ubi tres medici, duo athei." I am not concerned in tracing out for you, even if I were able to do so, the most probable origin of this defamatory saying, nor shall I spend many words in venting my honest indignation upon it as a calumny and a reproach. It will be wiser and more profitable in every way to take it as it stands—as an example of what the late Earl Russell said of proverbs in general—"the wisdom (or in some cases the foolishness) of many," accentuated and condensed into a telling phrase by "the wit of one." From this point of view it may be that there is something more or less worthy of careful reflection in this proverb, even if we should disown it in its literal acceptation. But I need scarcely say to those who are at all conversant with philosophical studies, that to have been accused of atheism in the middle ages may be quite the reverse of a real reproach to any man or set of men. From the time of Socrates downwards, indeed, this reproach has been a part of the stock-in-trade of vindictive, even if sincere, ignorance and bigotry all over the world; and to have been tabooed with atheism is often, almost without qualification, a passport into the ranks of those who have kept alive the flame of the human spirit, tending, and often vainly struggling upwards, to escape from the jargon of scholastic controversies and the mephitic vapours of ecclesiastical strife. From this point of view it was inevitable—nay, it was essential—that the physician or naturalist, in so far as he really was or aimed at becoming such, should incur this reproach. The marvel rather is, to us of this nineteenth century, that those who incurred it should have done so little to deserve it. The reproach from a philosophical point of view, inconsistent with atheism, but not seldom conjoined with it, of tampering in an evil sense with magic was sure to be launched in those days at men who professed to be successfully investigating the *secreta naturæ* by other than the most orthodox methods. And the prosecution and imprisonment of Roger Bacon on the one side and of Galileo on the other, not to speak of the numerous "martyrs of science" both before and after these, will remain as an imperishable record of the blind and impracticable spirit of mediæval dogmatism, which, covering itself with the mantle of religion, stood athwart the path of the physician for hundreds of years. But although the condemnation on the side of godlessness came most easily and naturally out of the mouths of ecclesiastics, it is not by any means to be inferred that, either in ancient or modern times, it has been confined to them. Even in the kindly and thoroughly human word-picture drawn for us by Chaucer, of the typical "Doctour of Physike," in the Prologue to the "Canterbury Tales," line 440, it comes out that while—

"Wel knew he the old Esculapius,
And Dioscorides and eke Rufus,
Old Hippocras, Hali, and Gallien,
Serapion, Rasis, and Avicen,

Averrois, Damascene, and Constantin,
Bernard, and Gatisden, and Gilbertin"—

yet, alas! as a sad balance in the way of defect to all this learning of ancient, and also of then quite modern date, it is quaintly and humorously added, in a single line, without even an attempt at amplification or excuse, that—

"His studie was but little on the Bible."

This, then, is the position and stigma that we have to deal with as physicians or students of Nature and science in the present, as in all former ages, in proof of which you will allow me simply to refer (without at all dwelling upon it) to an article in the actually current number of the *Contemporary Review.** I will, therefore, close this address with a very few thoughts of my own on the subject, not at all in the way of controversy or of recrimination, but as expressing the matured convictions of a lifetime on a theme which must needs come home to every man's conscience in the exercise of our profession, and on which I should despise myself if either the desire of saying smooth things or the fear of saying the opposite were to move me in the least degree in addressing an assembly like this.

That the active ministry of the healer, if fitly and diligently pursued in a serious and not a sordid spirit, cannot possibly tend to irreverence or to what I would call essential atheism or godlessness, is, I think, so obvious that it is only wonderful that any doubt should ever have arisen on the subject. That ministry is the ministry of the body, no doubt; physical, therefore, in its aim; physical also, to a certain extent, in its limitations; and I am not one of those who would argue that, because it is so, the physician is thereby degraded and straitened unless he is also constantly invading the province of the religious teacher. But when we consider how closely the one province trenches on the other, and, further, that in all the greater and graver crises of the lot of man on this earth—birth and death, sickness and health, moral contamination producing disease, and, on the other hand, physical disease inducing moral aberrations, and, with or without these, positive insanity—we must acknowledge that the spiritual element in man is brought necessarily into the sphere of the physician's daily work. I am confident there is not a man in this room who will not emphatically agree with me in saying that a physician who even inclines towards irreverence as his habitual attitude of mind is thereby disqualified from performing aright the greatest of all the services that at times he can render to the sick.

The physician of the future will, I believe, be much more, instead of less, inclined to study the Bible than hitherto, and in this respect will differ greatly from the representative and typical "Doctour of Physike" of the "Canterbury Tales." But he will study it in the spirit of modern scientific freedom and of historical research, not under the influence of mere tradition and ecclesiastical authority. And thus only, as it seems to me, can the reconciliation of science and religion ever be brought about.

The physician of the future will do well if he remembers always the pernicious despotism which has been exercised over his own art (though in a minor degree) by the fetters of these dead orthodoxies, and will therefore be very slow to acknowledge their claims upon him to any more than a historical regard, even in the realm of theology. He will say of them, in the noble words of the Westminster Confession, which (but for the formula connected with it in our Scottish churches) might almost be taken as the Magna Charta of Christian liberty in all such documents, "All synods and councils since the Apostles' times, whether general or particular, may err, and many have erred; therefore they are not to be made the rule of faith or practice, but to be used as an help in both."* But I desire you very specially to remark, as my own personal anticipation, shared, I have no doubt, by many of those now present, that the physician, in his character of student of Nature, will make, and in the end will establish, this claim to emancipation, not in virtue of any irreverent, much less atheistic tendencies, but for the very reason that he has access to a revelation of God distinct from the written revelation, and requiring a wholly distinct method of investigation. In obedience to this call he will, sooner or later, absolutely decline to walk in the leading-strings of ecclesiastical tradition. And in so doing he will (far from fulfilling old Dan Chaucer's satirical description) studiously insist upon the Bible, and especially the New Testament, and, above all, the recorded life, words, and works of our Lord Himself, as containing by implication the charter of his emancipation, and the only perfectly free religious atmosphere as yet opened to human thought and inquiry.—*Lancet.*

* "The Scientific Spirit of the Age," by Frances Power Cobbe, *Contemporary Review*, July, 1888, p. 126.

* "The Confession of Faith, Agreed upon by the Assembly of Divines at Westminster, etc.," chap. xxxi.: "Of Synods and Councils." 1643.

CORRESPONDENCE.

The Editor does not hold himself responsible for opinions expressed by his correspondents, nor can he take notice of anonymous communications. All letters must be accompanied by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

"WHENCE COMES MAN?"

Mr. Bell, the author of the above-named book, writes to complain of "a strange mistake" in the notice of it which appeared in your issue of July 27th. The "strange mistake" is the substitution of the word "private" for "privative," in a quotation from his book, and Mr. Bell finds therein reason sufficient for the expression "rigmarole" as applied to his remarks. I hasten to assure him that the mistake is due wholly to the printer, and that my critical comments are in no way connected with or influenced by it, as I perfectly appreciated his use of the word "privative," although I made no special allusion to it. As a matter of personal opinion I may perhaps be allowed to say that, with a little more care, Mr. Bell might easily have seen that no part of my criticism depended in any way on the "strange mistake."

THE WRITER OF THE REVIEW.

SHOWERS OF FROGS.

I read in the papers various accounts of "showers of frogs" of recent or former occurrence. But I do not see that any one, except "Korax," in the *Evening News*, alleges having actually seen the frogs falling. It may even be doubted whether he can be regarded as an eye-witness, since he merely speaks of people putting up their umbrellas "to ward off the living shower." Where the little amphibians are not seen in the act of falling, the probability is that they have come, not from cloud-land, but from some sheet of water. That whirlwinds may occasionally carry frogs up aloft along with other "unconsidered trifles" cannot be questioned, but such cases are doubtless rare.

S. D.

RECENT INVENTIONS.

The following list has been compiled especially for the SCIENTIFIC NEWS *by Messrs.* W. P. THOMPSON *and* BOULT, *Patent Agents, of* 323, *High Holborn, London, W.C.; Newcastle Chambers, Angel Row, Nottingham; Ducie Buildings, Bank Street, Manchester; and* 6, *Lord Street, Liverpool.*

DRINK.—A method of converting sea-water into a palatable drink has been patented by Mr. G. S. Hazlehurst. To accomplish this an effervescent such as lemon kali and a corrective such as bismuth are mixed with sea-water, the result being a refreshing saline beverage that may be drunk during effervescence without causing after-thirst. The bismuth is used to counteract the purgative effect of the sea-water, and it also acts as a sedative.

PRESERVING FISH.—A method of preserving fish has been patented by Mr. A. R. Roosen. Instead of covering the fish when packed, first with an antiseptic powder, and then with ice, as is usually done, they are packed with an antiseptic, in a frozen state, which more effectually preserves them. To prepare this antiseptic ice, the water is first sterilized by boiling it with steam; the desired antiseptic is then added, and the solution frozen as quickly as possible. The strength of the solution may be varied.

FOOTBALL INFLATER.—A football inflater has been patented by Mr. W. Fraser. The invention relates to a portable apparatus, and consists essentially of a combined plunger and air-chamber, working telescopically within an open-ended cylinder, with a coiled spring disposed between the bottom of the latter and a recess formed within the inner end of the former. The combined plunger, air-chamber, and cylinder are provided with valves respectively, the cylinder valve being at the entrance of the pipe of an outlet nozzle. The return movement of the piston is effected by a coiled spring placed between the underside of a cap on the end of a piston-rod and a bridge carried across the open mouth of the cylinder.

CAMERAS.—A shutter for photographic cameras has been patented by Mr. A. S. Newman. This shutter is made in two parts, which open inwardly on upright hinges at each side of the shutters, being arranged somewhat after the manner of a double casement window, and where the edges of same meet in the middle they are formed so that in shutting they overlap one another so as to make a light-tight joint, and in addition are padded at such joint, and also at the top and bottom, so as to ensure a light-tight fitting all round, the hinges being placed behind projecting flanges all round the opening. This shutter is actuated by a pneumatic cylinder and loose piston therein, actuated by the operator with a compression-ball and tube.

BICYCLES.—A rear-driving safety bicycle has been patented by Mr. C. Grant. This machine is so constructed that it can be ridden by females in ordinary dress. The backbone proper is kept on a level with a horizontal line through the centre of the back wheel, so as to keep it as low as possible, except near the front wheel, where it curves upwardly and is jointed to the front wheel standard. The seat standard is secured to the backbone close to the back wheel, and the treadle shaft is situated immediately beneath this standard. No stay is placed between the seat standard and the steering standard, and the portion of the backbone between the latter and the seat standard must be of sufficient length to afford ample room for a lady to enter between the same.

ELECTRIC SWITCH.—An appliance for making and breaking an electric circuit has been patented by Mr. H. K. Read. The switch employed in this invention consists of a centre spindle carrying a pair of cross-arms arranged so that one is immediately above another, and such that the extremities thereof are capable of embracing the contact pieces, the grip being capable of regulation by means of bolts and nuts near the extremities. To ensure a very quick "break," the handle is made independent in movement from the arms; its motion is conveyed to the arms through the intermediate action of a V-shaped spring, the two forks being pressed upon by pins on the collar, and the other end screwed down to the blade. Thus when the friction of the "contact" is absent the arm flies round very rapidly, the spring having been compressed before forcing the arms from the contacts.

MUSICAL INSTRUMENT.—A musical instrument has been patented by Mr. S. J. Talbot. The instrument is played by strings, and the resonant chamber is constructed of wood. To the back-board of the chamber is glued the curved front and the top and bottom pieces. The front board is provided with sound openings, and strings are stretched from top to bottom along the curved upper surface of the chamber, firmly secured at the bottom in any manner, and at the top attached to pins adapted to be turned by a key, so as to tune each string to the required pitch. The top of the front board is provided with a raised portion, on which is laid a curved upper bridge of metallic wire. A lower bridge is placed diagonally across the face of the instrument, and also consists of metallic wire. Below the lower bridge each string is secured by a small staple. Fifteen strings are usually employed, and the curve of the front board is such that a bow may be drawn easily across any string without touching the next. The instrument is made tapering, and in playing the bow is drawn across the strings between the two bridges.

PHOTOGRAPHIC FILM.—Mr. J. Brown has patented a photographic film. The invention relates to the preparation of gelatine on a temporary flexible support, which is finally removed after the photographic image is obtained either in its monochromatic state or after colours have been applied. The film is formed as follows:—A sheet of paper is taken and coated with gelatine rendered insoluble, when this is dry another coating of indiarubber is laid upon it, to which is added a mineral oil, and when this is dry it is coated with a solution of cotton wool prepared with acid and dissolved in ether and alcohol. After this has dried it is again coated with a solution of gelatine, and on this surface is placed a layer of bromide of silver emulsion. This bromide emulsion surface is ready to receive the monochromatic photographic image; for the polychromatic image colours are placed at the surface of the monochromatic image before the film of gelatine and gums is removed from its flexible support. After the colours are dry the film is transferred to a rigid support and the flexible one removed.

SELECTED BOOKS.

The Natural History and Epidemiology of Cholera. Being the Annual Oration of the Medical Society of London, May 7th, 1888. London: J. and A. Churchill. Price 3s. 6d.

Darwin, Charles. By Grant Allen (English Worthies). London: Longman, Green and Co. Price 1s.

A Text-Book on Steam and Steam Engines. For the Use of Students Preparing for Competitive Examinations, By A. Jamieson, C.E., F.R.S.E., Prof. of Engineering, Glasgow Technical College. With 200 illustrations and four folding Plates. Third edition. London: Charles Griffin and Co. Price 7s. 6d.

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METEOROLOGICAL RETURNS

For the ten weeks ending on Monday, August 6th, 1888. Specially prepared for SCIENTIFIC NEWS from official reports.

	Mean Temperature.	Rainfall.	Duration of Sunshine.
Scotland, East	52·8 degs., being 3·0 degs. below average.	8·2 ins., being 2·2 ins. above average.	378 hrs., being 25 hrs. below average.
England, N.E.	52·8 ,, ,, 4·6 ,, ,, ,,	9·0 ,, ,, 3·6 ,, ,, ,,	277 ,, ,, 106 ,, ,, ,,
England, East	56·3 ,, ,, 3·6 ,, ,, ,,	8·5 ,, ,, 3·2 ,, ,, ,,	310 ,, ,, 156 ,, ,, ,,
Midlands ...	55·3 ,, ,, 3·0 ,, ,, ,,	8·5 ,, ,, 2·7 ,, ,, ,,	286 ,, ,, 121 ,, ,, ,,
England, South	55·9 ,, ,, 2·9 ,, ,, ,,	8·7 ,, ,, 4·0 ,, ,, ,,	298 ,, ,, 151 ,, ,, ,,
Scotland, West	53·9 ,, ,, 1·7 ,, ,, ,,	10·6 ,, ,, 3·5 ,, ,, ,,	370 ,, ,, 31 ,, ,, ,,
England, N.W.	54·7 ,, ,, 3·6 ,, ,, ,,	9·7 ,, ,, 2·3 ,, ,, ,,	317 ,, ,, 88 ,, ,, ,,
England, S.W.	56·1 ,, ,, 2·9 ,, ,, ,,	9·6 ,, ,, 2·7 ,, ,, ,,	362 ,, ,, 110 ,, ,, ,,
Ireland, North	54·3 ,, ,, 3·0 ,, ,, ,,	11·3 ,, ,, 4·4 ,, ,, ,,	329 ,, ,, 3 ,, ,, ,,
Ireland, South	56·0 ,, ,, 2·0 ,, ,, ,,	11·4 ,, ,, 3·9 ,, ,, ,,	356 ,, ,, 18 ,, ,, ,,
The Kingdom...	54·8 ,, ,, 3·2 ,, ,, ,,	9·5 ,, ,, 3·2 ,, ,, ,,	328 ,, ,, 81 ,, ,, ,,

During the corresponding period of last year the rainfall for the Kingdom was 3·15 inches below, and sunshine 149 hours above the normal.

Scientific News
FOR GENERAL READERS.

Vol. II. | FRIDAY, AUGUST 24th, 1888. | No. 8.

CONTENTS.

SCIENTIFIC TABLE TALK.

By W. Mattieu Williams, F.R.A.S., F.C.S.

The recently published report of Dr. Hans Reusch, of the Norwegian Meteorological Institute, on the earthquakes that occur annually in Norway, appears to have surprised some of us who reside farther to the south, but a little reflection on the subject must show that Norway is one of those countries in which *à priori* considerations should lead us to expect a frequent occurrence of earthquakes.

It is well known that the regions surrounding our existing and active volcanic centres are specially liable to earthquakes. A glance at a map will show that the coast of Norway is just that part of the continent of Europe which is the nearest to the most active European volcanic region, viz., that of Iceland. The places specially named in Dr. Reusch's report are those nearest to Iceland.

The islands of Vaerö and Röst, where "doors and windows clattered and the slates of roofs were pitched off," are the outermost and southernmost of the Lofoddens those which stretch out the nearest towards Iceland. Bodö, also mentioned, is on the coast just opposite to them. Ytterö, another place specially named, is an island standing off the coast just opposite the southernmost extremity of Iceland, as Bodö, Röst, and Vaerö are opposite its northernmost extension, which just touches the Arctic circle. (See page 152 of this volume.) At and between these the maximum of shaking occurs.

It is further to be noted that a very remarkable physiographical feature of Scandinavia attains its maximum thereabouts. I refer to the terraces of till and alluvium which run up all the valleys opening on the west coast, whether those valleys be sea-paved and thus constitute the fjords, or whether they form the troughs of rivers or torrents in which all the fjords terminate.

Before knowing anything about the earthquakes of this region (1877) I wrote as follows of the valley which opens out in a fjord nearly opposite to Ytterö: "The valley of the Nid, like all the greater valleys of this region, is a gigantic staircase of two, three, or more, up to a dozen steps, the steps varying from 8 ft. or 10 ft. to about 100 ft. high, and with all breadths, from half a yard to a mile or two. The top of each of these steps, *i.e.*, of the terraces in this part of this valley, are beautifully flat—ready-made croquet-lawns if merely rolled and mowed."

The upper terrace in all these valleys is about 600 feet above present sea-level, but is less in the southern valleys. About half-way between Ytterö ("Hitteren" on many maps) and the arctic circle is a very curious island, Torghatten, which is perforated from east to west with a tunnel 530 feet long, 66 feet high from floor to roof at its eastern entrance, and 250 feet high at its western or oceanward entrance. The roof of the tunnel varies from 650 feet above sea-level on its west side to 530 on the east. It thus corresponds very closely to that of the 600 feet of the upper terraces of the valleys.

Many curious traditions concerning the origin of this tunnel are extant, in spite of which I ventured to suggest the following, in the first edition of "Through Norway with a Knapsack," published in 1859: "When the whole of the northern coast of Scandinavia was some 600 feet below its present level Torghatten was of course similarly lower, and the floor of this tunnel was washed by the low-tide waves. The waves of previous centuries had, aided by other agencies, such as frost and the gravitation of overhanging masses, formed this tunnel as an ordinary sea cavern, and the great upheaval had raised it to its present place."

Since the above was written the tunnel has been carefully examined by a Geological Commission of the University of Christiania, and their report confirms my general explanation, but shows that "frost and the gravitation of overhanging masses" have done more than I at first anticipated. The amount of *débris* on the floor is very great, and fully accounts for the additional 50 ft. of height at the end exposed to the full sweep of the ocean. The original solid rock floor is correspondingly lower than the present rubble floor, indicating, if the general explanation be correct, a gradual or step-by-step upheaval, corresponding to that displayed by the inland terraces.

I have seen "the Parallel Roads" of Glen Roy and Glen Spean, but interesting as they are, they are not comparable to the terracing of these Norwegian valleys. The causes materially differ. The shores of Glen Roy are those of an ancient lake formerly dammed by glaciers, first to a height of 1,140 feet above sea-level, then reduced by a breaking down of the dam to 1,059, then to 847 feet. The Norwegian terraces are ancient sea-shores, are in every valley there, and incomparably more distinct. One may walk above forty miles along some of them, as on an artificial esplanade, or sea-wall, which only terminates when the height of the bottom of the valley reaches its level.

On my visit to Norway in 1856 I walked from Christiania to Trondhjem, and first observed them in the Gula Valley, by which the road descends towards the sea. I struck into this valley on descending from the Dovrefjeld, near to where the upper terrace spreads out to form the bottom of the valley—*i.e.*, where the bottom of the valley is 600 feet above sea-level. Here was a fertile plain, such as may be found at a corresponding elevation in most of these valleys. Viewed thus from above, the terraces were very puzzling, but their true nature was fully revealed lower down.

The tourist of the present day will run over this ground by rail as I have subsequently, and in doing so will behold a magnificent panorama of these terraces, extending for miles not only along the main valley, but up the many branches of the tributaries to the Gula, each terrace winding about at its respective level in an unbroken curve. Referring to my diary, I find that I counted five in the main valley, at fifteen to twenty miles' distance from its mouth. These of course correspond to so many variations of relative land and sea level. Assuming that the differences were due to upheaval of the land, there must have been a series of great upheavals, with comparative rest between, during which periods of rest the material of these shores was deposited. The mode of deposition I must not discuss. It opens a wide field of interesting study, both of river deposition and glacier deposition. I will only add that at the present moment similar plains are to be seen on the sea-shore (as at Bodö, for example), which if upheaved would be cut down by the river, and thus form another and a lower terrace.

The present period represents one of quiescence between the upheavals, a period when there may be earthquakes amounting to such tremblings as are now occurring, but not sufficiently violent to cause a measurable variation of sea-level and convert a sea-shore plain into an estuary or valley terrace.

THE NATURALIST AT THE SEA-SIDE.

VI. Petrified Seaweeds.

At low-water mark on a rocky English coast begins a zone of bladder-wrack and tangle, which stretches down into considerable depths. Where these seaweeds fail, because the darkness grows too great for those peculiar chemical operations on which their nutrition depends, we find patches, sometimes miles in extent, covered with branching and often jointed organisms of stony texture and white, greenish, or purple in colour. The old naturalists considered these to be allied to the true corals, which indeed they resemble superficially, and named them *corallines*, or sometimes *nullipores*, from the absence of such pores as in most true corals lodge the polyps. They are now ascertained to possess no animal characters at all. Neither in nor around the stony skeleton is anything of polyp-kind to be discovered. The so-called skeleton is itself the living tissue—a mass of minute cells impregnated with carbonate of lime; and these cells are vegetable, and not animal.

The corallines (*e.g.*, *Corallina officinalis*) are small branched and jointed plants, consisting of many flattened fronds attached together by narrower articulations. If placed in weak hydrochloric acid (1:10) they become soft and flexible. Thin sections may then be cut and examined in glycerine. The fronds will be found to consist of crowded cells of rounded shape, which at the articulations pass into much elongated cells, or fibres. The cells are filled with granular protoplasm, and send very delicate fibres of communication from one to another; the cell walls consist of cellulose, and after the lime-salts are removed are very thin and fragile. The whole frond is covered by a sort of epidermis of flattened and rounded cells, which secretes a tender investing membrane. Reproductive organs, lodged in little hollow capsules, are borne at the ends of the branches. These are essentially similar to those of other algæ of the order Florideæ.

Nullipores (*e.g.*, *Melobesia*) have unjointed branching stems. They often encrust stones or other algæ, but some of the species have a tree-like mode of growth. Even at low-water mark or in deep shore-pools, which are never uncovered by the tide, claret-coloured crusts of nullipores may be found.

The colouring-matter of these curious plants is believed to be the same red pigment which tinges so many flexible sea-weeds. It is soluble in cold water, and may be removed readily from crushed and powdered nullipores. A green colour, previously masked by the red pigment, then shows itself, and this turns out to be chlorophyll, the ordinary colouring-matter of green plants.

The calcareous matter enormously preponderates over the rest of the tissues. It is no doubt obtained from sea-water in a state of solution, and precipitated in the cells. To this ingredient the corallines owe their rigidity and a certain degree of immunity from the attacks of browsing animals. The sea-snails, which devour ordinary seaweeds in vast quantities, cannot touch the corallines. Some fishes, however, have strengthened the armature of their jaws to such a point as to be able to grind up even this hard provender. But it is indirectly, not as food, but as a means of shelter, that the stony seaweeds are chiefly serviceable to the crowd of animals which throng the coralline zone. A bivalve (*Lima*) gathers their broken branches, and weaves them with threads of its own into a nest. Here many fishes lay their spawn in safety, colonies of hydroid zoophytes spread their feathery branches, and spider-crabs creep about what is to them a petrified forest. When the naturalist's dredge crashes through the spires and pinnacles of these submarine cities many a shy recluse, never washed ashore by winter gales, is dragged forth to the unaccustomed light of day.

The brittleness of the corallines determines their vertical range. In shallow waters which are swept by storms no slender and rigid architecture is possible. The tough and flexible seaweeds are here in place. Where corallines are found they give proof that the sea-bottom is vexed by no waves, and that no currents bring sand and mud to choke the rooted plants.

Diamonds in Meteorite.—According to the *American Naturalist*, at a meeting of the Philadelphia Academy of Natural Sciences, a fragment of a meteorite containing diamonds was exhibited by Professor H. C. Lewis.

SUN-DIALS, AND HOW TO MAKE THEM.—III.

A VERTICAL wall dial facing due south may be drawn in the same way, but in finding the centre the angle REA, Fig. 8, must be made equal to the latitude of the place. Fig. 11 shows a wall dial and a horizontal dial

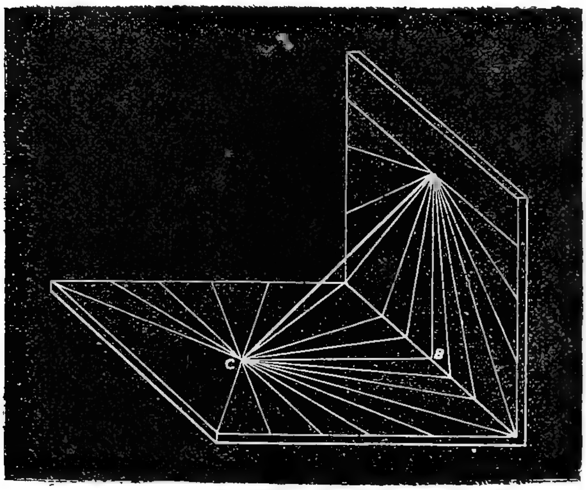


FIG. 11.

arranged with one style in common to both. It will be noticed that the corresponding hour lines meet at the line where the dials meet. At latitude 45° a wall dial and a horizontal dial would be exactly alike.

The geometrical construction of a wall-dial which does not face exactly to the south, is rather complicated for those who are not familiar with the art of projection,

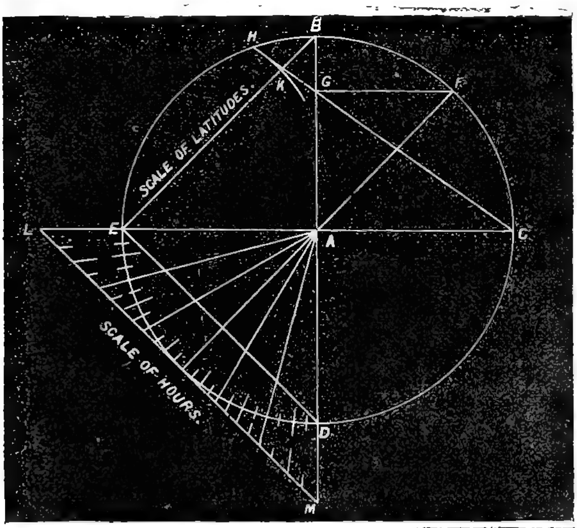


FIG. 12.

but the hour lines can be readily set out with the aid of an equinoctial dial by the following method :—

Ascertain the true north, and mark the direction on the ground, or on a temporary support beneath the proposed dial. This may be done with a compass, making the necessary correction for deviation, and taking care that there is no iron water-pipe near, since this might affect the compass. This line will be the meridian of the place, and is represented in Fig. 11 (which is a south dial) by the line CB. Draw a perpendicular line AB. Suppose the place to be near Manchester : we find

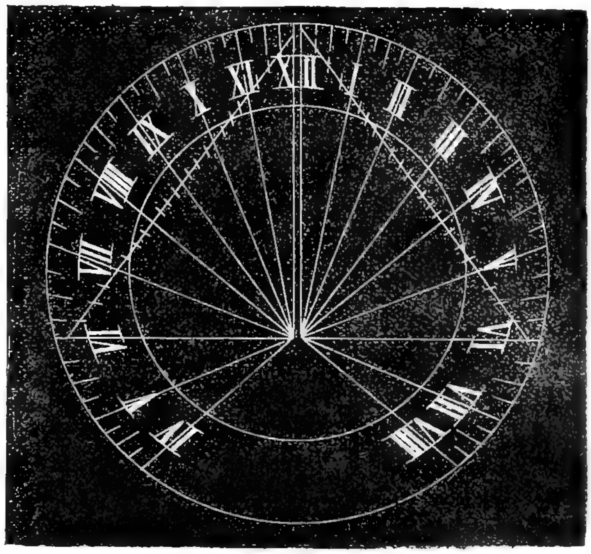


FIG. 13.

on a map that the latitude is about $53\frac{1}{2}$, and in the table of tangents of co-latitude we find the tangent would be ·738. Divide the line CB into 100 parts; this is easily done by making it $12\frac{1}{2}$ inches long; an eighth of an inch will be the one hundredth part. Make AB equal to 73·8 of these parts, or nearly $9\frac{1}{4}$ inches. Join AC by a thread, this will point to the north pole of the heavens, and will be the position of the style, or the edge of the gnomon.

Now take for an equinoctial dial a circle of card or tin,

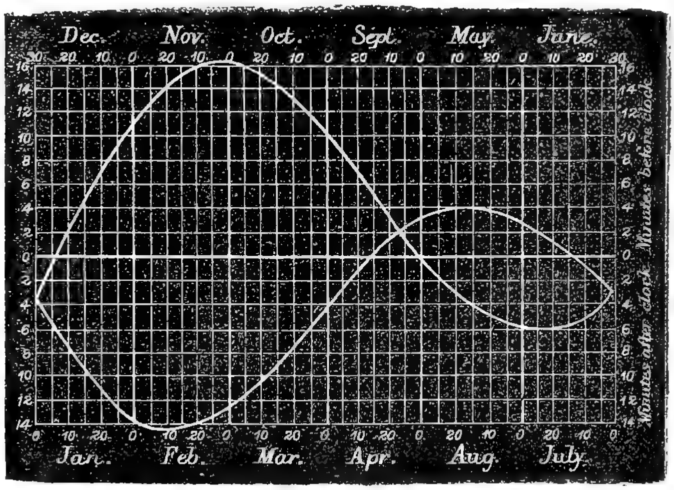


FIG. 14.

divided into 24 equal parts, and numbered as in Figs. 4 and 5. Hold it so that the thread or wire CA passes through the centre at right angles, and take care that the VI. VI. line is horizontal. Then with a candle or lantern cast a shadow of the thread on to the equinoctial dial and on the wall. When the shadow falls on the XII.

line of the equinoctial dial, it will fall on the position of the XII. line of the wall-dial, and so on for the other hours. A wall-dial cannot show the hours before VI. in the morning, or after VI. in the evening, unless it faces considerably east or west of south.

If the dial faces otherwise than due south, and is provided with a gnomon whose plane is at right angles to the dial, it will not stand upon the noon line, as in a true south dial, or a horizontal dial, but will be more or less inclined to it. The line on which the style or gnomon stands is called the substylar line. A dial of this kind may be seen on the tower of St. Clement Dane's in the Strand, near the Law Courts. The substylar line is on the XI. line in this case.

It will be observed that if the dial be arranged for latitude 90, that is, for the pole, the point R, Fig. 8, will be identical with the point F. This will be the centre of the dial, and if the hour lines be drawn it will be found that they simply radiate at equal angles of 15 degrees. The proof of this the reader will find to be an easy and not uninteresting problem.

The following method of dividing a dial was extensively used by the dial makers, since not only the hours, but the quarters and even minutes, can be set out with little difficulty. The method consists in the use of scales with specially prepared graduations. These scales are often to be found in old sets of instruments, but their use is almost forgotten.

There are two scales, the one a "scale of latitudes," the other a "scale of hours." The former is graduated as follows:—From the centre A, Fig. 12, draw the circle BCDE, regarding BD as poles, and EC as the equator; mark off F as the latitude of the place, the angle CAF being the angle of latitude. Draw FG parallel to EC, and from C draw a straight line CGH through G, cutting the circle at H. Join BE. From the centre E, at the distance EH, draw an arc of a circle, cutting EB at K. The point K represents the latitude of the place on the scale of latitudes EB. The scales are usually marked with every degree from 0° to 60°.

The scale of hours is of simpler construction. Divide the arc DE into six equal parts for the four lines, and sub-divide the hours into quarters or minutes. Join ED, and draw the line LM parallel to ED, touching the circle. From the centre A draw lines through the divisions on the circle, cutting the line LM. LM will be a scale of hours.

The scales are used thus:—Draw the meridian line AB, Fig. 13, or if a thick gnomon is to be used draw a double line. Draw the VI. line at right angles, and from the centres of the dial set off on both sides the distance EK on the scale of latitudes, along the VI. line. Then take the scale of hours, and, placing one end at the point thus found, let the other end fall on the meridian line. Straight lines drawn from the centre through the divisions on the scale of hours, will give the hour lines and other divisions on the dial.

On the circumference of a circle of $5\frac{3}{4}$ inches diameter, a division representing five minutes of time is about one sixteenth of an inch long.

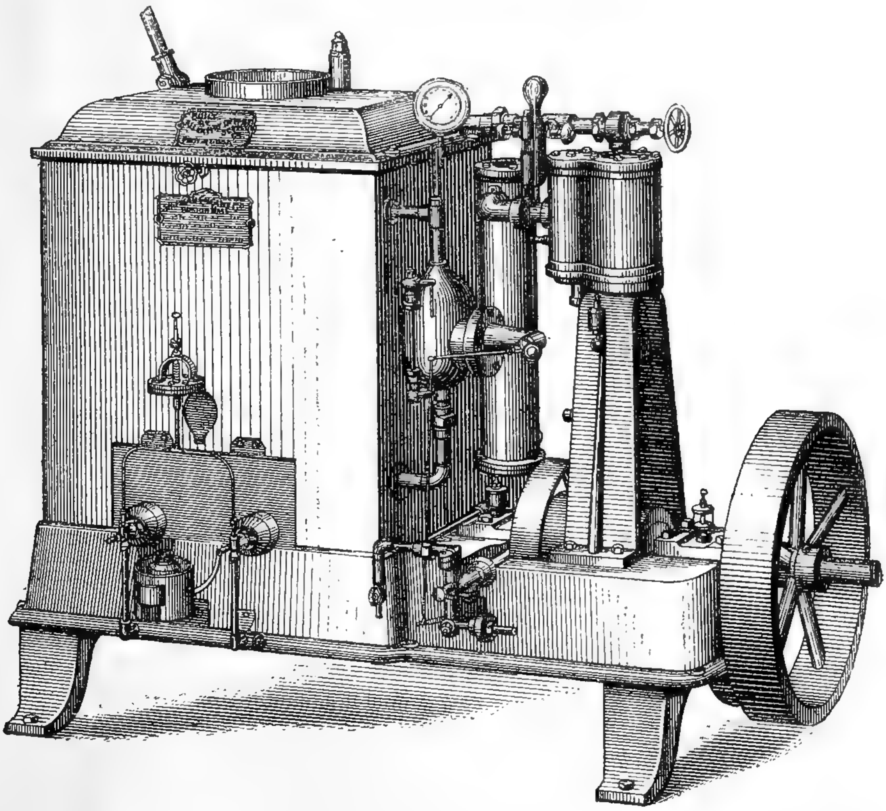
An ordinary sun-dial will only show the correct time on or about the 15th of April, 15th of June, 1st of September, and on Christmas Day. On other days a correction must be made by adding or subtracting from the time as shown on the dial. This correction is called "the equation of time," and varies slightly from year to year, the second year after leap year being about the mean; this variation, however, amounts only to a few seconds, and therefore does not concern us here. The following table should be provided in some form or other with every dial. The seconds have been omitted, and the days are given on which A stands for "add," and S stands for "subtract." For example, on the 1st of January, when the sun-dial shows 10 o'clock, the real time is four minutes past ten. Again, on the 5th of December, we should have to substract nine minutes from the time as shown on a dial.

Jan.	1—A	4	Apr.	25—S	2	Sept.	30—S	10
„	6—A	6	May	15—S	4	Oct.	7—S	12
„	11—A	8	June	5—S	2	„	15—S	14
„	15—A	10	„	14—	0	„	28—S	16
„	23—A	12	„	25—A	2	Nov.	9—S	16
Feb.	1—A	14	July	5—A	4	„	21—S	14
„	22—A	14	„	23—A	6	„	26—S	12
Mar.	4—A	12	Aug.	16—A	4	Dec.	3—S	10
„	12—A	10	„	25—A	2	„	8—S	8
„	20—A	8	Sept.	1—	0	„	12—S	6
„	25—A	6	„	7—S	2	„	16—S	4
Apr.	1—A	4	„	13—S	4	„	20—S	2
„	8—A	2	„	18—S	6	„	25—	0
„	15—	0	„	24—S	8	„	28—A	2

This table may be represented by the diagram Fig. 14, which explains itself. It may be arranged in other ways, and there are a number of different modifications of the ordinary sun-dials by which, if the time of year be known to within a day or two, the true time can be read off at a glance. It should be noted that if it is desired that Greenwich time be shown, a constant correction of four minutes per degree of longitude must be made. This is to be subtracted if the place be to the west of Greenwich, and added if it be to the east.

THE SHIPMAN AUTOMATIC ENGINE.

THE chief objections to the more general use of small steam yachts and launches are the difficulty in carrying fuel to run them when coal is used, and the cumbersomeness of the engines, which require a trained engineer to keep all in order. These difficulties have been largely overcome by the introduction of the Shipman automatic steam-engine, of which we give an illustration. The fuel used is petroleum, and the boilers are made of wrought-iron and steel, tested up to 350 and 400 pounds hydrostatic pressure; it is said that they are absolutely safe against either fire or explosion. Steam and oil are discharged together in a very fine spray through an atomizer into the fire-box, the supply of oil being automatically controlled by the steam pressure in the boiler operating upon a diaphragm, which may be set at any desired limit, so that when the pressure reaches this limit, the supply of oil is entirely cut off until the pressure drops again. The oil tank is placed at any convenient distance from the fire-box, so that there should be no more danger in using petroleum, in the way it is supplied by this system, than in ordinary lamps. The water supply is also automatic, the feed water pump being in operation, whenever the engine is in motion, and a ball-float connected to the cut-off valve in the pump regulating the supply. The combustion is as perfect, and ordinarily as free from smoke, as in a well-trimmed lamp. Until the steam pressure is obtained in the boiler, an air pump is worked by hand to feed the fire. This is only necessary for a few minutes, and the fire afterwards takes care of itself, just sufficient oil being automatically supplied to keep the steam pressure within the limit which has been set. This arrangement prevents waste of fuel, as the supply of oil to the fire-box is always controlled by the amount of steam taken to work the engine, the engine itself putting out its fire when no steam is taken, and relighting it again. The average quantity of oil used per horse-power per hour is said to be about two quarts. The simplicity of construction and the excellence of material used in this engine, with its automatic water and fuel feed, well adapt it for all uses where it is desired to dispense with the services of a fireman or engineer, while its compact form renders it especially available for use on small steam yacht



pleasure boats. It is also suitable for all stationary purposes, as well as for marine work.

EXTINCT BRITISH BUTTERFLIES,

And the Continuity of Existing Species by Means of Migration Considered.

(*Continued from p.* 160.)

THE other species mentioned, namely, *Pieris daplidice*, *Argynnis lathonia*, and *Lampides boetica*, though single specimens of each of these have, at different intervals, for a long succession of years been taken on our southern and south-eastern shores, they all seem incapable of breeding here in a state of nature. A single instance is on record of a female *Pieris daplidice* which was captured near Dover, depositing some ova which were kept in confinement and produced three imagines the following year. Most of the species mentioned above were once probably truly indigenous to this country, but adverse climatic influences have done their work, and they are no longer able to find here a permanent home.

Only about fifty years ago five species of copper butterflies belonging to the genus *Polyommatus* occurred in this country, while now there is only one—namely, the Small Copper (*Polyommatus phlœas*).

The Large Copper (*Polyommatus dispar*) used to occur very abundantly in the counties of Norfolk, Suffolk, Huntingdon, and Cambridge, and its extirpation in these districts has been attributed by one author to the rapacity and greediness of collectors, though far more probably the drainage of the fens this insect used to frequent is the real secret, its pabulum, the great water-dock (*Rumex hydrolapathum*), being a marsh-loving plant and only able to thrive in such situations. We may also mention that this butterfly has been recorded in times gone by from several midland localities in South Britain, and was therefore once probably found over a very wide area in this country. In addition to the Large Copper (*Polyommatus dispar*), three allied species—namely, *P. chryseis*, *P. hippothöe*, and *P. virgaureæ*—all used to occur in this country.

The former of these (*P. chryseis*) is recorded to have been taken by that eminent entomologist Dr. Leach in Epping Forest, for several successive seasons, in abundance, and was also said to have been captured in Sussex.

Polyommatus hippothöe was formerly found in Whittlesea Mere, in company with *P. dispar*, and also, it is said, in Kent, while *P. virgaureæ* used to be taken in Cambridgeshire (the Isle of Ely) and in Huntingdonshire.

Alas, all these beautiful insects are now extinct, and in future we may only hope to see their elegant forms in books! (Many specimens of *Polyommatus dispar* still exist in cabinets.)

It is to be hoped that our only living species of the genus may long be spared to grace our collections.

Of the *Lycænidæ*, or "Blues," a very interesting species which has become extinct is *Lycæna semiargus* (=*L.acis*). Only about twenty or thirty years ago this butterfly used to occur in a great number of localities in England and Wales, but, strange to say, it has entirely disappeared, and no longer finds a place in our lists.

The butterfly under consideration used to occur plentifully in one locality near Birmingham, but is not found there at all now. In this case its extirpation has been attributed by a local entomologist to the ravages of picture-makers. Here, then, man is the principal instrument in exterminating a species. He is probably answerable for many more.

The extinct "Satyrs" are represented in this country by the following; namely, the Silver Ringlet *(Hipparchia hero)*, which was formerly taken on the borders of Ashdown Forest in Sussex, and the Arran Argus *(Hipparchia ligra)*, specimens of which were captured in the Isle of Arran by Sir Patrick Walker and Mr. Alexander Macleay, but no examples of either species have been seen for many years.

A very interesting species of butterfly which formerly inhabited this country is the Goddess Fritillary, probably better known as Weaver's Fritillary *(Melitœa dia)*. The interest in this insect is derived from the great controversy which held sway for some time in the scientific magazines of the time regarding its claim to be inserted in the British lists. It was first captured by Mr. Richard Weaver, in Sutton Park, in Warwickshire, and a little later by another collector, Mr. Stanley, in Cheshire.

Mr. Weaver, who was the discoverer of this pretty butterfly, was treated in a very disgraceful manner by the entomologists of London and Paris, and great thanks are due to Mr. F. O. Morris, the well-known author, for his vindication of the character of this collector. Concerning *Melitœa dia*, we have recently been informed by the Rev. Canon Bernard Smith (late of Oscott College, near Birmingham), who knew Mr. Weaver personally, that the identity of the insects (two in number) in the cabinet of the fortunate collector was established by a friend; for then Mr. Weaver was only a beginner, having taken up the study of entomology to benefit his health. He was a bootmaker by trade. The fraud attributed to him by less fortunate collectors (who were probably jealous of his discoveries), of palming off foreign insects as British, is entirely without foundation, as Mr. Weaver did *not* collect foreign insects, for he used to say that the British were more beautiful (the insular prejudice held its sway in those days).

Mr. Montagu Browne, F.Z.S., curator of Leicester Museum, informs us that he saw the specimens of *Melitœa dia* (in addition to the specimens of *Polyommatus dispar* and *Lycæna semiargus*) in Aston Hall Museum, Birmingham, about twelve years ago, the same that were reported to have been caught in Sutton Park by Mr. Weaver. Unfortunately, the present curator of Aston Hall Museum does not know the rudiments of entomology, and cares for it, possibly, even less; but one could scarcely have believed that such rare insects should have been allowed to rot in the cellar of this scientific institution (?), yet this is too surely the case.

In addition to the species mentioned in this essay which have become extinct, there are many others of which we possess only faint records.

We should, however, like to caution our readers against accepting the supposed occurrence of many European species in this country, such, for instance, as *Colias myrmedome* and *C. chrysotheme* of English authors, which are merely varieties of *Colias edusa*, and also such as *Lycæna dorylas* which is supposed to be only a pale variety of the common blue *Lycæna icarus* (= *L. alexis*). In addition to these, there are many others which have been erroneously introduced into our lists at various times, either through want of authenticity, identity, or confusion of synonymy. Unscrupulous dealers are also answerable for a great many errors which have occurred in past times, by palming foreign specimens as British upon unsuspecting collectors. We now, however, live in a scientific age, and the facilities for cheating are not so great as formerly.

The remarkable fluctuations in the appearance of many butterflies would afford in itself a very fertile topic. During a certain season a particular species suddenly becomes abundant, though for several years previously it may have been very scarce and only occasionally met with. In 1884 the Red Admiral *(Vanessa atalanta)* occurred throughout the country in the utmost profusion, though for several years previously it had been comparatively scarce. In the following year the beautiful Peacock *(Vanessa io)* occurred in great abundance in several midland localities, though it had been very uncommon for a number of seasons. Many other similar instances have come under our notice. How these striking occurrences are brought about we are not able to ascertain at present, until more is done towards the elucidation of the economy of the species in question. How far, therefore, they are due to migration is at present involved in mystery; but apparently there is some kind of periodicity in these remarkable appearances which may eventually prove to coincide with a periodicity in the seasons of their migration.

Many species of butterflies migrate about from one part of the British Isles to another, in which case it would only be a local migration, and probably quite independent of any outside influences.

There are many other species, undoubtedly independent of migration, which sometimes appear in immense numbers locally, such, for instance, as *Thecla rubi*, *Lycæna argiolus*, *Gonepteryx rhamni*, *Argynnis selene*, and *A. euphrosyne*, which are in other seasons very scarce; then, again, others, which are usually tolerably plentiful, such as *Polyommatus phlæas*, *Euchlöe cardamines* and *Pieris napi*, are very scarce in certain seasons, though apparently there is no accounting for the phenomena. There is very wide scope, therefore, for any one who may wish to take up this interesting subject. What is greatly wanted is a number of trustworthy observers and reliable recorders in different parts of the country, with a well-organized staff to collect and arrange the data furnished.

The recent progress of science forcibly teaches us that the grandest and safest conclusions are best attainable by means of the most minutely accurate observations, persistently conducted according to some well-arranged and comprehensive plan.

In the numerous cases cited above numberless experiments are being carried out before our eyes, and if we are to profit by them we must watch them with the clearness of vision and keenness of intellect demanded by the physicist in his laboratory.

General Notes.

Earthquake in Maine.—A sharp earthquake shock was felt in the vicinity of Winthrop Maine, on the night of the 14th inst., but no damage was caused.

Geology of the Balkans.—Professor Toulo, of the Polytechnique School of Vienna, has been sent to Bulgaria to make a geological survey of the eastern slopes of the Balkans.

Earthquake at Honduras.—This catastrophe, though occasioning great damage, has not proved destructive to life. Curiously enough, it coincided in time with the eruption of Takamatsa, in Japan.

Exceptional Heat in Northern Europe.—Whilst Britain and France have lately suffered from abnormally low temperatures, the thermometer in Norway has reached heights such as have never been recorded in the present century. At Christiania the readings in the shade have several times been 30° to 32° C. = 86° and 89° Fahr. In Varanger Fiord, near the White Sea, the temperature at the end of June reached 95° Fahr.!

The Scottish Astronomer-Royal. — Mr. C. Piazzi Smyth, Astronomer-Royal for Scotland, and Professor of Practical Astronomy in Edinburgh University, has resigned these offices after holding them for forty-three years. His reason for retiring is, he states, not only advancing years, but "despair of ever being able to do anything good or compete with other observatories when the Government continue to refuse to do what their own Commission recommended."

The "Henry" Respirator.—M. Henry, of the Brussels Fire Brigade, has devised a respirator which enables men to remain with safety in places filled with smoke, ammoniacal gas, mephitic emanations, etc. It consists of a light metallic mask, covering the nose, the mouth, and the chin, whilst its sides form a double screen. In one there is wadding saturated with glycerine, and in the other a layer of sponge, which at the moment of use is sprinkled with an appropriate liquid, such as lime-water, which absorbs carbonic acid in case of burning buildings, or a solution of sugar of lead if it be necessary to enter cesspools, sewers, etc.

A New Comet.—From a circular just issued from Lord Crawford's observatory at Dunecht, we learn that another new comet has been discovered by that most indefatigable and successful American discoverer, Mr. W. R. Brooks. The present comet was found at his new station, Geneva, U.S., on August 7, when its position was R.A. 10hr. 5min., Dec. 44deg. 30min. north. The place is near the third magnitude star Lambda, in the Greater Bear. No particulars are given of brightness, but it is stated that it is moving eastwards.

Electric Conductivity of a Vacuum.—According to *Cosmos*, as certain physicists, such as Goldstein, Edlund, and others, have maintained that a vacuum is a good conductor of electricity, Prof. A. Foeppl has resolved to verify this supposition. The circuit having been formed of homogeneous gases, highly rarefied, the passage of the current ought to manifest itself in various manners whether by its action upon a magnetic needle or by the production of induction currents. The experiments, though carried out with great skill, led to a conclusion absolutely opposite to that of Goldstein, that a vacuum does not conduct electricity.

Fires Extinguished on Ship-Board.—A process devised by Messrs. Coates and Carver, of Manchester, has recently been tried with success at Liverpool. The process consists in turning the products of combustion from the boiler-furnaces into the hold where the fire is raging. A French contemporary remarks that the carbonic acid and *carbonic oxide* gases given off by the furnaces come here in play. Now that carbonic acid gas extinguishes fire is well known, but no reliance can be placed upon carbonic oxide, which is distinctly inflammable. It must not be inferred from this comment that we question the value of the invention, which in the trial made was splendidly successful.

Government Aid to Agricultural and Dairy Schools.—The Lords of the Committee of Council for Agriculture have awarded the following sums out of £5,000 granted by the Government for the present financial year in aid of the agricultural and dairy schools, viz.:—The Cheshire County Dairy School, £150; Aspatria (Agricultural) School, £250; Edinburgh University, £300; Glasgow and West of Scotland Technical College, £200; Kirkcudbright Dairy Association, £70; Ayrshire Dairy Association, £125; Wigtownshire Dairy Association, £101 10s.; and to Dumfriesshire Dairy Association, £28 10s. The applications from the British Dairy Farmers' Association, the Norfolk Chamber of Agriculture, and others were deferred for further consideration.

Falling Stars and Meteoric Dust.—*Apropos* of the now recurring showers of shooting stars, a correspondent of the *Vossische Zeitung* mentions the probability that Professor Nordenskjöld's experiments have decided in the affirmative the question whether the remains of shooting stars that have been burnt in our atmosphere are found on the surface of the earth. Nordenskjöld caused large masses of snow to be melted, and found left behind a very fine powder, which proved to be metallic iron. The first experiment had been made in Stockholm so that it was not impossible that this iron dust might be of terrestrial origin; therefore the experiment was repeated in the Finnish forests, with a similar result. Still more decisive was it when the experiment was repeated with the snow in Spitzbergen, more than 400 miles from any human dwelling; and metallic iron was found there also in the form of a fine dust, which makes it extremely probable that the cosmic significance of this iron is connected with the shower of falling stars. Of whatever kind the combustive product of these falling stars may be, it is certain that it must fall on the earth, and that it gradually increases the mass and weight of the latter in a manner which is not unimportant, considering the ages during which the earth has existed and is likely to exist.

International Geological Congress.—This Congress meets only once in three years, and it is to hold its next meeting in London from September 17th to the 22nd.

The Congress originated in 1876, at the Buffalo meeting of the American Association for the Advancement of Science, and meetings have since been held at Paris, Bologna, and Berlin. It is expected that the London meeting will much exceed in numbers any previously held, as over 200 foreign and colonial geologists from twenty-one countries have already notified their intention of being present, while the number of British geologists will be at least as large. The meeting will be held at the London University, Burlington Gardens, and among the questions to be discussed will be the geological map of Europe; the classification of the Cambrian and Silurian rocks, and of the tertiary strata, and the Organising Committee propose to devote a special sitting to a discussion of the crystalline schists. The excursions at present suggested are—(1) The Isle of Wight—cretaceous, eocene, oligocene. (2) North Wales—pre-Cambrian and the older palœozoic rocks. (3) East Yorkshire—jurassic and cretaceous. (4) Norfolk and Suffolk—pliocene (crag) and glacial beds. (5) To the jurassic rocks of central England. (6) West Yorkshire—silurian and carboniferous limestone. The short excursions during the week of the Congress will probably be to Windsor and Eton, St. Albans, Watford, Brighton, Erith, and Crayford, etc., and the Royal Gardens at Kew.

The Late J. C. Houzeau.—The funeral of this eminent *savant* took place on July 15th at three p.m. The usual discourses were pronounced on the occasion by Lieut.-General Liagre on behalf of the Belgian Academy of Sciences, by M. F. Folie in the name of the Observatory, and by M. Ch. Ruelens on behalf of the Royal Belgian Geographical Society. Jean Charles Houzeau de Lehaie was born at Mons in 1820. He studied first at the college of his native town and afterwards at the University of Brussels. His career of research in physics, astronomy, meteorology, and climatology opened in 1843. In 1846 he became an assistant at the Observatory. Here, however, his political tendencies became incompatible with the discharge of his duties, and he resigned in 1849. In 1857 he emigrated to America, spending several years in Texas, Mexico, and Jamaica, and making a number of valuable observations in natural history. The first of his labours appeared in his "*Etudes sur les facultés mentales des animaux comparées à celles de l'homme,*" a work published in 1872 at Kingston, in Jamaica. Here he distinctly declared that man differs from the lower animals not qualitatively, but quantitatively, and rejects the assumed distinction between "reason and instinct." In 1870 he returned to Belgium as Director of the Observatory. Space does not permit us to enumerate the researches of the departed, but we do not hesitate to say that if he had eschewed politics, and especially Socialism, he would have been a second Humboldt.

The Public Health.—The Registrar-General's return for the week ending August 11th shows that the deaths registered last week in twenty-eight great towns of England and Wales corresponded to an annual rate of 17·6 per 1,000 of their aggregate population, which is estimated at 9,398,273 persons in the middle of this year. The six healthiest places were Derby, Huddersfield, Portsmouth, Hull, Sunderland, and Bristol. In London 2,228 births and 1,476 deaths were registered. Allowance made for increase of population, the births were 454 and the deaths 203 below the average numbers in the corresponding weeks of the last ten years. The annual death-rate per 1,000 from all causes, which had been 15·9 in each of the two preceding weeks, rose last week to 18·0, and exceeded the rate recorded in any week since April last. During the first six weeks of the current quarter the death-rate averaged 16·0 per 1,000, and was 5·4 below the mean rate in the corresponding periods of the ten years 1878-87. The 1,476 deaths included 51 from measles, 17 from scarlet fever, 25 from diphtheria, 27 from whooping-cough, six from enteric fever, one from ill-defined form of continued fever, 138 from diarrhœa and dysentery, five from cholera and choleraic diarrhœa, and not one from small-pox or typhus; thus 270 deaths were referred to these diseases, being 164 below the corrected average weekly number. In Greater London 2,929 births and 1,791 deaths were registered, corresponding to annual rates of 27·6 and 16·9 per 1,000 of the estimated population. In the outer ring 21 deaths from diarrhœa, four from measles, and four from diphtheria were registered. The fatal cases of diarrhœa included four in Mortlake and five in Walthamstow subdistricts.

The Archæological Institute.—The excursion last Tuesday week commenced with a visit to Hatton, where the fine old church in which the celebrated Dr. Parr ministered has given place to a modern edifice. The building was inspected, and Baddesley Clinton Hall, with its moat, were examined. The party next proceeded to Knowle, and made an examination of the church, a description of which was read by the Rev. Canon Howe. Solihull was the next place visited, where the party were received by the Rev. M. Hartwright, the curate, who opened the registers, which date back to the time of Henry VIII., and which contain curious entries of persons who had died unbaptized or excommunicated, and had been buried in wool. The company then paid flying visits to Meriden and Berkswell, the churches at these places being explained by Mr. W. G. Fretton, F.S.A. At the evening meeting, Sir T. Baker presided, and proposed a vote of thanks to the Mayor and Corporation of Leamington for the hearty reception and hospitality extended to the Institute on the occasion of its present visit to the Royal borough. This was unanimously adopted. Wednesday, the concluding day of the congress, was spent in a journey by train to Melton Mowbray, where the noble parish church was inspected under the guidance of the vicar, the Rev. Mr. Collins, and its restoration by Sir Gilbert Scott was admired, as was also the architecture of the western entrance, which forms a sort of "Galilee." After luncheon, the first halt was at Burton Lazars, where the church was inspected. A drive of some three miles took the party on to Burrow or Burgh Hill, where Colonel Bellairs read a paper mainly based on Nichol's "Leicestershire," in which it is asserted to be an undoubted Roman encampment, and such appeared to be the opinion of the party, though many thought it to be Roman work imposed on the British fortification. The other churches visited in the afternoon were Ashby Folville and Gaddesby, both very interesting in their several ways, and the last named being remarkable for its fine, pure, and external carved decorations, and for its wooden seats of the 15th century. At half-past five the party reached Ratcliffe College, over which they were conducted by Father Hirst. After inspecting the college chapel and library, they returned to Leicester.

PORTABLE MAGIC LANTERN.

A VERY compact form of magic lantern is illustrated in the cuts accompanying this article. It is adapted for all experimental purposes, as well as for the projection of views. The best way to give a correct

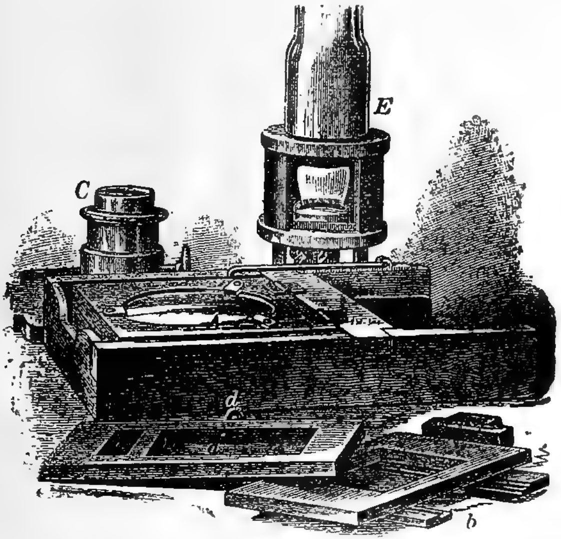


FIG. 1.

idea will be to take, as example, a $4\frac{1}{2}$ inch condenser lantern, and give the dimensions of the different parts, as shown in the cut. The size of the condensers settles the question of the measurements of the other parts.

The two condenser lenses, plano-convex, are mounted each in a separate board. A circle is turned out with a rabbet in each board, in which the condenser seats itself,

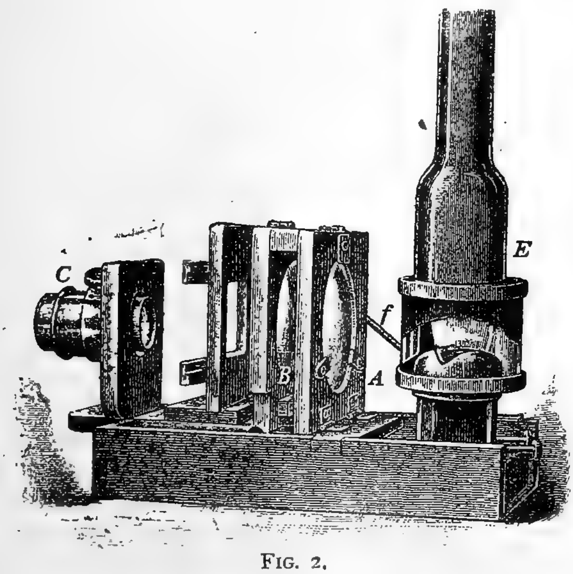


FIG. 2.

and is secured therein by three buttons. The rear condenser board, A, is $6\frac{3}{4}$ inches square. The front board, B, is of the same width, but $8\frac{1}{4}$ inches long. To the rear one a strip is screwed across the top edge, and the front one is hinged to this strip. At their bases, coming between them, two small abutting strips are secured. The thickness of the strips is such that the boards, when brought together, with the strips in contact, are strictly parallel, and the lenses are held apart from each other.

The frame or base of the lantern is a rectangle, a little over $6\frac{3}{4}$ inches across, and 13 inches long in internal measurement. It is closed at the front and open at the back of the lantern. It is $2\frac{1}{2}$ inches deep; $7\frac{1}{2}$ inches from its front, the back condenser board is hinged to a strip that runs across the top of the frame, and is screwed firmly thereto, flush with its upper surface. A long brass hook, *f*, and staple is provided, for holding the condensers in place when vertical. The boards are held together, when desired, by another shorter hook, *c*, with staple. The condensers are then in place for horizontal projection. To arrange them for vertical projection, the small hook, *c*, is unfastened, the front condenser, B, is pushed up until the two are at an angle of 90°, and a plane mirror is inserted, resting

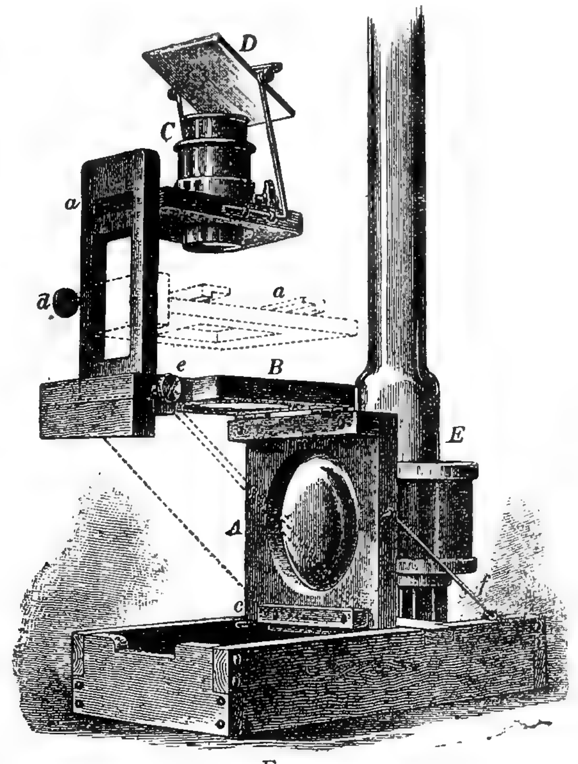


FIG. 3.

against the two bottom strips. The mirror should be mounted on a thin board or on a brass plate, so as to provide strength and protect its back.

A mortise is cut in the front condenser $6\frac{3}{4}$ inches from its top, $\frac{5}{8}$ inch wide and $3\frac{1}{8}$ inches long. A piece of board, *a*, is cut to slide smoothly back and forward through this mortise. For retaining the strip in any desired place, a hand screw, *e*, is placed on the side of the condenser board, which is notched at both its lower corners. A strip of brass is attached to the side of this strip for the screw to press against.

The strip carries the slide carrier *b* and lens *C*. The lens is attached to a board about 4 inches wide and $5\frac{1}{2}$ high, with a tenon projecting from its base. A mortise is cut near the end of the sliding strip to receive this tenon.

A second mortise or slot, $4\frac{1}{8}$ inches long and 2 inches wide, is made in the strip *a*. The slide carrier, *b*, is a board $6\frac{1}{2}$ inches high by $4\frac{1}{2}$ inches wide. To its base is attached a piece of wood 3 inches square. This is $\frac{1}{2}$

inch thick, and below it is a second piece of the same length, but just 2 inches wide. The second piece enters the slot in the sliding strip, *a*, and the slide carrier rests upon the shoulders formed by the upper block. A hand screw, *d*, is arranged to hold the slide carrier in any desired position.

A smaller movable mirror, *D*, is supplied to be supported above the objective when the lantern is to be used for vertical projection.

A piece of sheet iron is fastened across the bottom of the main frame, on which the lantern, *E*, rests. In the front of the same frame a notch is cut in which the piece, *A*, rests. To make its position in the front condenser board more secure, a second strip may be attached just below the mortise and to the back of the board.

For lantern any good form of screened lamp may be used. If necessary, a sheet-iron box may be arranged to inclose the source of light; but with such a lantern as is here shown it is quite unnecessary.

In the drawings, Fig. 1 shows the whole ready for mounting, the lamp being lighted and ready for work. The lamp should always be lighted before beginning, as it may take five minutes for it to attain its full power. Fig. 2 shows the whole put together and arranged for exhibiting views. By removing the slide carrier the entire space between condenser and objective is free for the introduction of apparatus or performance of experiments. A soap bubble can be blown and projected in this space. A glass of water can be very prettily shown, and the lantern will be found admirably adapted for the experimenter's use. Fig. 3 shows the lantern arranged for vertical projection, the outline of the mirror being given in dotted lines. As the slide carrier is not always used for work in this position, it, too, is shown in dotted lines.

If all is properly constructed, the apparatus will be susceptible of all kinds of adjustments. The sliding board, *a*, can be moved back and forth in the mortise in the front condenser board. The slide carrier can also be moved backward and forward. By these two adjustments the slide carrier can be brought to any point desired in the cone of rays converging from the condensers. By moving the lantern backward and forward, any modification in the direction of the light rays emerging from the condenser can be given.

A lime-light can be used instead of an oil lamp; but as the object was to show a portable lantern, the former has been shown in the cuts.—*Scientific American.*

NOTES FOR YOUNG COLLECTORS.

THE following notes, the result of long experience abroad, may not all be available for entomologists in Britain. But in view of the increasing facility and cheapness of travelling and the frequency of emigration, it may be hoped that more and more of our rising entomologists will no longer confine themselves to British insects, but go out to wider and less threadbare fields. In no other part of the world is so much annoyance sustained from the trespass laws and from the interference of gamekeepers. In other countries, so long as you do not encroach upon lands under actual cultivation, you need fear no interference.

Perhaps the first caution to be observed by the young collector is to avoid the interior of forests, as comparatively barren. Their margins, whether bordering on arable land, pastures, heaths, or pieces of water, are very generally found fruitful. Lanes or avenues cut through a dense forest often yield a rich harvest. So do openings of a few score yards in width, screened from the wind on all sides, especially if they include a pool or a patch of marshy ground. One of the best of all localities is a clearing where the trees have just been removed and the stumps are still standing.

A great variety of lepidoptera, and not a few beetles, especially the splendid *Buprestidæ*, come to feast on the sap oozing out of the wood.

Chalk, sand, and gravel pits, especially if they have been left undisturbed for some time, are always worth a careful examination. The margins of foot-paths leading across pastures and meadows and through corn-fields are often rich in *Elateridæ*, especially species of *Gtenicera.*

Stony and shingly districts are often rich in ground-beetles, *Carabs, Harpalidæ*, etc., which may be found by cautiously turning the stones over. This applies, however, only in localities where stones are naturally prevalent. A casual heap of stones in other localities rarely yields anything worth picking up.

Rivers in time of flood are often very prolific. If the collector provides himself with a small water-net with a long handle, and takes his stand at some point where the current is obstructed—*e.g.*, by the piers of bridges, jetties, etc.—he may sometimes scoop up beetles by the pint, *Geodophaga* of almost every description occurring in the neighbourhood, *Necrophaga, Geotrupidæ*, and many others. The best way is to bring away the whole lot, and sort them at home. Those not wanted should be set at liberty, as by far the greater number of those likely to be thus captured are harmless, if not actually beneficial. You will find that Carabs, to all appearance drowned, will, if laid in a sunny spot, gradually revive and run away.

Certain localities are to be avoided as not likely to be worth the time spent upon them. Such are districts swarming with ants, whether they be woodland, heath, or desert. Here the larvæ, the pupæ, and all adult insects haunting the ground and the lower trees (with the exception of certain species which seem to live on friendly terms with the ants) will have been devoured. Grass-lands which are mown repeatedly during the course of the summer—as it is often done in Switzerland—are of little use, since many species of plants are thus extirpated, and the insects which feed upon them are banished. The neighbourhood of a flourishing rookery is seldom rich in insects; these birds are very diligent and successful in digging up and devouring buried larvæ and pupæ, and in ransacking small carrion, dung, etc., for a variety of insects.

Where moles abound the prospects of the collector, at least as far as certain groups of insects are concerned, are not very bright. Land which has been heavily dressed with chemical manures is often shunned by insects, whilst, on the contrary, many kinds flock where farm-yard manure, night soil, crushed bones, etc., have been applied.

Plank-fences and the sides and tops of sheds and out-houses which have been recently coated either with gas-tar or wood-tar may be let alone by the collector, for they will assuredly be boycotted by insects.

Very much depends upon the kind of weather. Prolonged drought and prolonged wet are equally objectionable to our creeping and flying friends. They prefer a mixture of sunshine and showers, with as little wind as possible. In tropical climates the beginning and the end of the rainy season, and especially any intervals of fine weather which intervene, are good times for collecting.

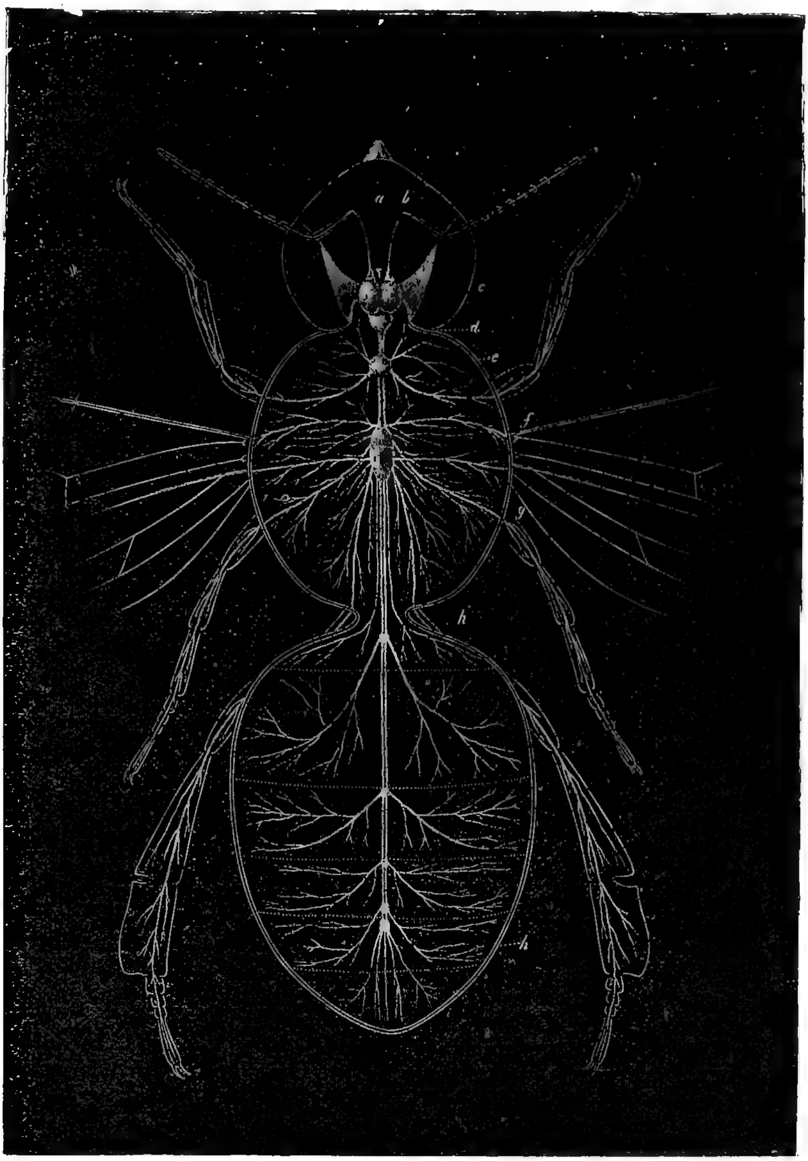
Natural History.

THE SENSES OF INSECTS.

I. Preliminary.

The manner in which, throughout animated nature, the nervous system deteriorates, so to speak, by slow but sure degrees as we pass downwards in the scale, cannot fail to have greatly struck all those who have enrolled themselves as workers in the field of comparative anatomy. This system attains, of course, its highest perfection in man, whose intellectual requirements have to be provided for as well as those mental and physical needs which he possesses in common with many of the lower animals, while that same intellect endows him with special capacities for the appreciation of pleasure and pain, which in their turn also imply an unusual completeness in the development of the nervous system. Then, as we work our way from mammals to birds, birds to reptiles, reptiles to fishes, and fishes to invertebrates, each descending step shows us a corresponding deterioration, until in some of the lower forms of life we fail to discover any traces of a nervous system at all.

Especially do we find this to be the case with the brain. In man, of course, that organ is quite unique in character, greatly excelling in comparative bulk, and still more in quality, that of any other animal. But putting man altogether upon one side, and taking the monkey type as the most physiologically perfect, we may trace the gradual degradation of the brain even in the mammals, which degradation, becoming still more marked in the birds, the reptiles, and the fish, ends in the apparently complete effacement of the organ in question in that most singular creature the *Amphioxus*, which seems to be a link between the vertebrates and the invertebrates, connecting the two great classes together.



Nervous System of Bee.

In the molluscs, however, which stand foremost in the invertebrate class, the brain reappears, but now in a different form. In place of a localized organ, situated in the head, we find it broken up, so to speak, into a number of *ganglia*, or miniature brains, placed in different parts of the body, but communicating with one another by a double chain of nerves, which may or may not be analogous to the spinal cord possessed by higher forms of life. This structure is still more strongly marked in the case of the Insects, with which we have now more particularly to deal; and in them the brain may be defined as divided into eight, nine, ten, or more portions, lying in a chain extending from the head to the extremity of the abdomen, and connected with one another in the manner above described.

Now this distribution of the nerve-centre into different regions of the frame leads to one most important result, for it restricts, and restricts very greatly, the functions of that particular ganglion which for our present purpose it will be convenient to term the brain, although it is in reality but a small portion of that organ. In all the higher animals the brain is, of course, the ultimate terminus of every nerve in the body, the seat of all sensation, intelligence, and volition, and the centre of that nervous activity which enables the vital functions to be maintained. Pain, in whatever part of the system inflicted, is felt by the brain; motor stimulus, of whatever muscle or muscles, proceeds from the brain. And it is also the recipient of those impressions which are due to the sensory organs, and which are conveyed to it by special nerves, modified in character to suit their special purpose. Thus its functions are many and complex, and it becomes, as it were, the one great director and commander-in-chief of the whole physical and mental organization.

But in the insects it is not so. From each of the ganglia in the ventral chain proceed nerves which, branching and ramifying again and again, supply motor force to those regions of the body in which they lie, or provide for such sensory properties as may be necessary for the individual species. Thus a very considerable proportion of those functions which in vertebrate animals are apportioned to the brain are in lower forms of life dissevered from the cephalic ganglion, which may be taken as representing that organ, and transferred to such nerve-centre as may be nearest to the region or the members in need of supply. Each ganglion, in fact, is a kind of subordinate or deputy brain, a seat of motor and sensory power for the service of a certain portion of the body. And so the head-brain, or principal ganglion, is set almost wholly free for the reception of impressions conveyed to it by the sense-organs, and for the transmission to the secondary nerve-centres of impulses consequent upon those impressions. At the same time, it is probably affected, although not in any great degree, by sensations experienced even in the remoter regions of the body, for otherwise it were hard to explain the function of the *double* communication-cord which links all the ganglia together.

Another result follows upon the first. The functions of the brain being, as we have seen, almost wholly restricted to the reception of sense-impressions and the transmission of impulses to which those impressions give rise, it is only natural to infer—more especially as the ganglion in question is of considerable size—that such impressions must be unusually keen, or at least those appertaining to senses whose external receptive organs are peculiarly developed. We might consider, for instance, that the sight of insects would be especially perfect, considering the wonderful array of eyes, often in two or even three forms, which are ordinarily present. And such is in fact the case, as we shall subsequently see when discussing the individual senses. Insects are beings whose very nature, whose bright and vivid life, whose matchless activity render highly developed sense-organs an absolute necessity. They are primarily creatures of the air, and that fact alone implies the possession of perceptions unusually acute. Such we find to be the case in the bat, whose highly sensitive wing-membrane endows it with a sense of touch so marvellously perfect that it can *feel* the presence of an object when several inches away. Such we find to be the case with the birds, whose eyes combine in themselves the properties of both telescope and microscope, and also possess the power of altering their focus with almost incredible rapidity and exactness. And such, too, is the case with the insects, whose sight, scent, and hearing are in many instances very highly developed, while it is at least an open question whether they do not possess other senses unknown to ourselves, but of great and indeed inestimable value in their own daily lives.

What, for example, are the functions of the antennæ? We cannot connect them with any of the five senses which we generally recognise, yet their invariable presence surely points them out as organs of extreme importance. They are occasionally employed as instruments of touch, it is true, as in the case of the ants. But this is the exception and not the rule; and, on the other hand, we find that those insects in which they are developed to the greatest extent never employ them for such purposes at all. And what can be their office? For it is not Nature's way to provide bodily members in any animal without at the same time apportioning duties for those members to fulfil.

The possession by insects of additional senses, however, is a possibility and nothing more. However far the progress of science may take us, we shall never be able positively to assert either that such senses are present or that they are not. And for this simple reason, that, not possessing them ourselves, we cannot form any idea whatever of what they may be in others. One blind from his birth could call up no idea of colour, neither could its character be explained to him. A man born without nerves of taste could never be brought to understand the nature of flavour. And in the same way we can form no notion of any sense which is not a development of one or more of those which we ourselves possess. Thus, in discussing the presence in insects of an additional sense or senses we are passing the bounds of science altogether, and entering upon the regions of pure speculation; and to bring the question into scientific limits is from its very nature—or perhaps it would be more correct to say from *our* very nature—impossible. We must, therefore, confine our investigation to those five senses of which alone we can take any cognisance; and these, as developed in insects, we will discuss in turn in subsequent papers.

Sulphur as a Remedy for Locusts.—An interesting fact in connection with the late inroad of locusts in Algeria, is that one vine has escaped alone in the midst of a vineyard where otherwise not a leaf has remained undevoured. A few days before the arrival of the swarm this vine had been well dusted over with sulphur as a cure for mildew.

THE BOTANY OF BRISTOL.—I.

FOR natural history purposes the neighbourhood of Bristol may fitly be considered co-extensive with the area of the Bristol coal-fields as defined in the geological map of Mr. Sanders. A district thus limited has already been adopted by local entomologists, geologists, and botanists, in portraying the Bristol features of their respective branches of science; and to the student it is an undeniable advantage to carry on field work of this kind within boundaries which are substantially natural, instead of drawing an entirely arbitrary line around the city taken for a centre. We speak of the Bristol district, therefore, as bounded on the west by the Severn and the Bristol Channel; on the south by the river Brue, which falls into the mouth of the Parrett, just below Burnham; and as extending north to the town of Berkeley, and east to the cities of Bath and Wells. Portions of North Somersetshire and of West Gloucestershire are included in this area, and are separated, save for a short distance, by the river Avon, which, passing through Bath and Bristol, joins the Severn at Avonmouth. Obviously we have here an extensive tract of country to work over. However, one may justly say that every part of it is not only of great interest to the naturalist, but is easily accessible from Bristol. In these days facility of locomotion is so great that a run of ten or fifteen miles out and home is within the reach of anyone who has half a day to spare. By rail, by cycle, or by "Shanks's pony" (and the field botanist being essentially a pedestrian will commonly prefer the latter) every portion of the district can be reached and explored without undue fatigue or an unendurable tax upon a slender purse. Moreover, our chief botanical wealth lies in the immediate neighbourhood of the city, where, upon St. Vincent's Rocks and on the Downs, in the Avon Gorge, Leigh Woods, or the Frome Valley, the stranger who visits Bristol in search of plants, while rambling amid delightful scenery, will become acquainted with many of the greater rarities. Before mentioning these plants in detail it will perhaps be well, for the benefit of readers unfamiliar with the country, to give a brief topographical sketch of its natural features and surface condition.

The city of Bristol lies in a somewhat triangular basin at the confluence of the rivers Avon and Frome, the latter a small tributary from the north-east, which flows through the picturesque Glen Frome, and is not to be confounded with the larger stream passing by the town of that name. Around the city arise hills which are more or less broad tablelands or plateaux. The steep acclivities on the north are beds of carboniferous limestone and millstone grit. To the south the swelling slopes of Knowle and Totterdown extend to Dundry Hill, which rises to 769 feet above mean sea level. Solid Jurassic beds are the cause of the existence of this high ground, which bounds the horizon for a considerable sweep. On the east of the city there is an irregular elevation, with an average height of about 180 feet. This extends from the river Frome on the north-east to the cliffs which bound the Avon by Conham and Brislington, and consists for the most part of coal measures, containing the sites of numerous coal-pits. It is the hard Pennant sandstone of the coal period, which is cut through by the Avon in the picturesque winding of the river by Conham. The influence of the tide is shut off near this point, and the river being locked becomes a canal joining the Kennet and Avon system, and forming, before the development of railway traffic, one of the most important links of inland navigation between Bristol and the Metropolis. Travelling eastward, the riverside scenery and botany change to the commonplace, and from the Pennant valley to Bath do not invite our special attention. In its tidal course to the Severn below Bristol the river passes by the Hotwells, under Clifton and St. Vincent's Rocks, and onward between the cliffs and quarries of the Avon Gorge. Lower down it passes through an extensive tract of alluvial flats drained by numerous intersecting ditches, chiefly brackish. These abound with algæ and other interesting matter for investigation. Small brooks, draining respectively Bedminster Meads and Ashton Marshes, with the meadows behind Long Ashton, flow into the Avon at Bedminster and Rownham. Other principal sources of drainage in the district are the Chew, the Trym, and the Axe. The former runs through rich pastures between Dundry and the Mendips, by way of Chew Magna and Stanton Drew, falling into the Avon near Chewton Keynsham. Most excellent botanizing is to be had throughout its course.

Either on the banks of the Chew or on ground rising from them a number of good plants may be gathered, including *Helleborus viridis*, *Viola odorata*, *V. alba*, *V. Reichenbachiana*, *Saponaria officinalis*, *Stellaria umbrosa*, *Rubus silvaticus*, *R. Radula*, *Rosa subglobosa*, *Epilobium roseum*, *Senecio saracenicus* in profusion, *Inula Helenium*, *Mentha sylvestris*, *M. piperita*, *Polygonum Bistorta*, *Daphne Laureola*, *Salix alba*, and the barren plant of *S. fragilis*, which is unknown elsewhere in the district; *Populus canescens*, *P. tremula*, *Orchis latifolia* (type), *Juncus compressus*, *Calamagrostis Epigejos*, *Glyceria plicata*, *Polystichum aculeatum*, and *P. angulare*.

The Trym is a smaller stream of less importance. It collects the drainage from the high lands about Henbury, and passing through Westbury and Coombe Dingle, falls into the Avon at Sea Mills, amid a submaritime marsh flora.

Besides the already mentioned Dundry, there are in the vicinity of Bristol some isolated hills of an altitude of from 250 to 300 feet. But the chief elevations are on the great Mendip range, a few miles to the south-east, and among the southern spurs of the Cotswolds, which come down into the north-eastern portion of the area as far as Wotton-under-Edge. The latter afford some enjoyable rambles from stations on the Midland Railway, being sometimes wooded, and their slopes sprinkled with abundance of belladonna, lily of the valley, *Polygonatum officinale*, and good orchids; or open and grassy, flecked with patches of *Hippocrepis*, *Trifolium medium*, *Rosa tomentosa*, and *Brachypodium pinnatum*. This grass has foliage of a bright yellowish-green colour, contrasting strongly with the brown hue of the turf around, and rendering the spots where it grows conspicuous at a long distance.

The Mendip Hills are, for the most part, huge masses of limestone, rocky and precipitous in places, but chiefly consisting of rough pasture and rugged slopes, presenting to-day the same features and appearance that they did when Roman miners delved and pitted their surface in the search for ore. The levels vary up to the top of Black Down, a wide expanse of elevated open moor and heath rising to an altitude of over 1,100 feet. The only true bog we possess occurs upon this range. In consequence, we find on Mendip several paludal species that are unknown or uncommon elsewhere about Bristol; for example, *Viola palustris*, *Peplis Portula*, *Scutellaria* *minor*, *Eriophorum vaginatum*, and *Lastrœa spinulosa*. Other noteworthy plants associated with these hills are *Helleborus viridis*, *Thlaspi occitanum*, *Alsine verna*, *Gnaphalium sylvaticum* and *Herminium Monorchis*. Cheddar deserves to be treated separately on account of the great natural phenomena there exhibited, and the exceptional richness and peculiarity of its flora. The grandeur of its magnificent cliffs and caverns will amply repay a traveller, even if he have journeyed far to witness it; and the delight of a botanist can be imagined when, for the first time, he sees above and around him fine tufts of the beautiful *Dianthus cæsius* conspicuous with colour, nestling in clefts and crannies of the heights. Underneath by the roadside are *Sedum rupestre (majus)*, *Saxifraga hypnoides*, thrown as a matted mantle over the rocks; and, earlier in the year, *Cochlearia officinalis*, with *Cerastium pumilum*. Here and there large yellow blossoms of *Meconopsis* make a brave show, and the limestone screes bear abundance of *Phegopteris Robertiana*. If his vasculum be not yet filled to repletion, the student may venture on the critical task of determining how many forms of *Thalictrum* grow at Cheddar; and should he do so, it is not lack of material which will hinder a satisfactory conclusion.

Below the zone of undulating moorland, breezy heath, and old grey rock there are many little rivulets winding and turning down the boggy slopes until lost in the sphagnum where the sundews grow; and stretches of aboriginal copsewood afford suitable spots for many sylvestral plants. *Lithospermum purpureo-cæruleum* makes its home on the sunny borders of these woods. The splendid hue of its petals, its porcelain fruit, and remarkable mode of growth give it a high place in our estimation apart from its rarity. Here too the Bee Orchis makes a profuse display when it chooses; but, as is well known, the appearance of most Orchids is uncertain and seemingly capricious.

The Mendips in Somerset and the Cotswolds in Gloucestershire alike, each overlook a great alluvial plain, stretching away westward to the Severn and the Bristol Channel. Reclaimed from the sea at some distant date, these extensive tracts are now fertile pasture, rich in aquatic and paludal species that find congenial stations in the frequent marshes, ditches, still pools, and sluggish drains. Approaching the Channel shore, numerous estuaries and tidal inlets locally termed "Pills" materially add to the number of our plants, and influence in some degree the character of the vegetation to a considerable distance from their waters. About their banks such plants as delight in a saline soil or atmosphere, but shun the exposure of the open coast, find suitable resting places. The coast itself, a long and little-varied line of sand and mud bank, with now and then a low cliff or a bank of shingle, offers all the conditions required by many maritime species.

From what has been stated it will be evident that the neighbourhood of Bristol possesses widely varying peculiarities of physical configuration and geological structure, and furnishes nearly every kind of locality that a botanist desires for his researches. One may even say that the additions of mountain and bog are mainly all that are required to render the Bristol district a typical portion of Great Britain. The distribution of plants being largely dependent upon the nature of these features, the flora is, as might be expected, proportionately extensive.

(To be continued.)

Reviews.

Transactions of the Cumberland and Westmoreland Association for the Advancement of Literature and Science. No. XII., 1886-7. Carlisle: G. and T. Coward.

The Cumberland and Westmoreland Association is a league entered into by nine societies in the two counties, though individuals not belonging to any of the above bodies may become direct members of the Association. Of the affiliated societies, one only, the Carlisle Scientific Society and Field Naturalists' Club, is devoted to science alone, the remainder, like the Association in general, being concerned with both literature and science. Each affiliated society has the right of recommending one original paper for publication in the Transactions, and such as have more than 150 members may send in two such papers.

The number of papers in the volume before us is not very great. The literary portion includes "Memoirs on the Maryport Camp," "Brampton in 1745," and "Former Social Life in Cumberland and Westmoreland." The scientific section includes "Zoological Record for Cumberland, 1886," by Rev. H. A. Macpherson, M.A., and W. Duckworth; "Our Summer Visitors," by T. Duckworth; and "Ice Work in Edenside," by J. G. Goodchild, F.G.S. Of the nine affiliated societies, three have contributed nothing to the Transactions. This is much to be regretted. In the "Zoological Record" and in "Our Summer Visitors" some interesting facts are placed on record. Thus, from the former memoir we learn that on a recent occasion a dipper (*Cinclus aquaticus*) was observed capturing a small fish in the Calders. "The dipper emerged from the stream, and on reaching shallow water released the captive, which made off at once for deep water. After allowing the fish a start, the dipper darted after it, and recaptured it, subsequently releasing and recapturing it alternately, until tired of play; the fish was then bruised by repeated pecks and swallowed head foremost. The deplorable mortality in May, 1886, among small birds, especially swallows, is duly noticed. In one case twenty swallows were found dead on the window-ledge of a small clay cottage; in another the exhausted birds invaded a smithy in search of warmth and food.

The authors have reason to believe that in the Carlisle district the white wagtail (*Motacilla alba*) occasionally interbreeds with the pied wagtail (*Motacilla lugubris*).

It is suggested by Mr. Eagle Clarke that many birds in their autumnal migrations pass from Scotland to North Wales by way of the Isle of Man, *avoiding* the coasts of Cumberland and Lancashire.

The persecution to which that harmless and useful bird the night-jar is subject is no less rampant in Cumberland than in other parts of the kingdom. An incident here given confirms Waterton's opinion that the average gamekeeper is a ruthless assassin and, as far as in him lies, extirpator of every bird not in the game-list.

The author of "Ice Work" concludes that a period of 20,000 years since the close of the Glacial Epoch is amply sufficient to account for all the denudation that can be demonstrated to have been accomplished in post-glacial times.

It is worthy to be noted that concerning the alternate glaciation of the two hemispheres geologists are not absolutely unanimous. Mr. J. G. Goodchild considers that in the north the glacial period is now waning, while in the Antarctic region the glacial period has not long ago set in. Others contend that the northern hemisphere reached its greatest warmth some five centuries ago, and is now on its way back to a glacial condition.

Management of Accumulators. By Sir David Salomons, Bart. Fourth edition, revised and enlarged. London: Whittaker and Co.

We gave unqualified praise to this book in our recent notice of the third edition, both because it contained a great deal of useful information upon a subject too little understood even by many electrical engineers, and because it filled a want, as has been amply proved by its rapid sale. We hoped in the present edition, which is said to have been revised as well as enlarged, to find that the serious faults not only in literary style, but in grammar, would have been corrected. Faults, such as those which meet the eye even on the first page, may be pardoned in the early attempt of one who is wrapped up with the importance of the information he has to convey; but are inexcusable in a fourth edition which "has undergone a thorough revision."

We hope to find improvements in future editions, and in the meantime, despite one or two technical statements of doubtful accuracy, it is on the whole an extremely useful handbook.

My Microscope and Some Objects from my Cabinet. By A Quekett Club Man. London: Roper and Drowley.

From the advertising pages at the end of this book we learn that the "Quekett Club Man" is also the author of a work entitled "My Telescope." It will doubtless surprise our readers to find one and the same man fully familiar with two instruments used in such very different sciences, and being at once a microscopist and a "telescopist."

The Quekett Club Man has only eighty small pages to devote to his subject, and is hence obliged to consult brevity. But we fear that a reader who is "under the cloud of innocence on the subject," will find some little difficulty in understanding the first section, entitled "The Instrument." He will be apt to ask, what is this or the other accessory apparatus, and how is it to be used?

The author's caution against buying a microscope without the advice of an expert, and against low-priced instruments, is very sound. The number of bad microscopes now made is something frightful, and frightful, too, is the bewilderment into which they may lead the tyro.

In the chapter on "Diatoms" the "Quekett Club Man" mentions an "irreverent friend" who when shown such an object exclaimed, "What a waste of beautiful work! for the chances must have been a million to one that no one ever saw it."

But such thought is even more unscientific than irreverent, since it involves the old delusive notion that everything exists for man's use and gratification.

The following is a somewhat curious sentence: "The great guns of the microscopical world differ on the question as the poles from the antipodes." We scarcely can agree with the author in the following passage; speaking of a geometrical spider (*Epeira*) he says, "Suddenly behind him a fly gets entangled; as by electricity, the news is conveyed to him, and with the quickness of thought he turns, darts, and seizes the intruder." Now, unless the prey ensnared is comparatively large, the spider has to apply her feet in succession to different radii of the web, that she may judge by the vibrations in what direction to rush. For despite their eight eyes, the sight of spiders is not remarkably good.

The little work before us will doubtless call increased attention to the value of the microscope as an instrument of research, and on this probable result the author is to be congratulated. But we do not hope that it may serve to augment the number of that very common class of microscopists who do not intend to devote themselves to any science, but prepare and accumulate a collection of whatever is small enough to be gazed upon through a microscope.

ROMAN BATH AND RECENT DISCOVERIES.—I.

When the British Association visited Bath in 1864 all that was known of the Roman baths and of other remains of the Roman city was to be gathered from Camden and from Leland, with such accompanying information as could be found in Horsley's "Britannia Romana" and in the works of Dr. Mugrave, Dr. Guidott, Dr. Sutherland, and Dr. Lucas.

Warner had recorded all that he could collect in his "History of Bath," and more fully in his illustrations of Roman antiquities discovered at Bath, published in 1797. The remains preserved in the Literary and Scientific Institution had been carefully catalogued by Mr. Lonsdale, with the assistance of Mr. Hunter, who resided in Bath for some years. From time to time, as the foundations of new buildings were cleared and the level of the ancient city was reached, fine tesselated pavements were laid bare, and have been preserved *in situ*. These can now be seen under the Mineral Water Hospital, the Blue-coat School, and the United or Casualty Hospital.

Mr. Lysons, in the second part of his "Reliquiæ Romanæ," has illustrated and described the remains found under the present Pump-room when that building was erected, and has given conjectural restorations from fragments of sculpture then discovered.

Carter had also delineated some of the antiquities.

The beautiful bronze head found in digging a sewer in Stall Street, in 1727, had attracted much attention, and was for some time preserved in the Guildhall, but has since been removed to the Literary and Scientific Institution. It is generally supposed to be that of a statue dedicated to Minerva, who is known from Solinus to have been the goddess presiding over the hot springs. To this writer we are indebted for an account of the city in Roman times; for his description can apply to none other in Britain, and his account has been quite confirmed by past and recent discoveries.

Discoveries made in 1755 had brought to light detached portions of the grand system of baths underneath the houses of the present city, and from observations then made conjectural restorations had been given of buildings which must have reached from the present abbey church to the Pump-room and beyond it. In the year that the British Association met there (1864) was published an account of the Roman antiquities up to that date. This work, entitled "Aquæ Solis, or Notices of Roman Bath," is now out of print.

To understand the Roman city some idea should be given of the ancient walls and the gates as well as roads that entered it. The walls seem to have conformed to the nature of the ground and the bend of the river Avon, so as to include the hot springs. The structure of the mediæval walls appears to have rested upon the Roman. This has lately been found to be the case at Chester, and was undoubtedly the case at Gloucester and at Colchester. The recent examination of the walls at Chester has thrown light upon this subject. (See last number of the Journal of the Archæological Association.)

The earliest map of Bath is probably that of Dr. Jones (1568 or 1588), which is contained among the Sloane MSS. (2596), from which we see the main streets meeting nearly at right angles, answering to the four gates. The circuit of the walls is a little above one mile, or a third less than the more important Roman-British cities. The line of the walls, often nearly destroyed, and greatly damaged in mediæval times, can still be traced. Within the walls the *forum* seems to have occupied a central space, and to have extended from the present abbey church to the Grand Pump-room Hotel. Under the last-named building Roman remains were found, and a concrete flooring, at a depth of not less than sixteen feet. The arrangement of the baths seems to have occupied the whole of the south front of the forum. Under the present Pump-room were found the remains of the sculptured pediment preserved in the vestibule of the Literary and Scientific Institution. Immediately opposite the Pump-room formerly stood Stall's church, which is recorded to have embodied in its structure the remains of a Roman temple. The position of the Roman forum can, therefore, be said to have occupied the present site of the abbey churchyard, the space from north to south being wider than at present. The position was not quite central, but extended more towards the east and south gates.

The present Pump-room, under which the sculptured pediment referred to above was found, marks the *entrance* to the Roman baths, but the frontage stood farther back, more to the north. The portico was probably composed of six columns in front, with a frontage of 35 feet, a height about the same, and a projection of not less than 20 feet. (See " Guide to the Roman Baths," p. 7).

In 1878 the reservoir which supplied these baths was discovered and laid open, also the Roman culvert, which has been reconstructed in places, and is now used as a drain for the waste water from the thermal springs. The hot springs were found to have been enclosed in an irregular octagon, 50 feet in length from east to west, and 40 feet wide. This is situated below the King's Bath, and forms the great well of the springs. A concrete floor has been laid over it, and the space above is still used for modern baths. The Roman reservoir is built of large masonry, 3 feet thick by 6 or 7 feet in length, and was found to be cased on the inside with lead.

In clearing out this reservoir leaden pipes and shafts of columns were found, also blocks of stone variously moulded. From this tank the great Roman bath, not far distant, and the circular bath (only recently discovered) were supplied with hot water.

The hall of the great bath, now completely opened to the view, encloses an area of 111 feet in length by 68 feet in width, but the circular bath and the hall in which it is situated have been arched over, as the space above was required for modern use. The Roman masonry, however, is carefully preserved, and distinctly marked off from the more recent additions.

It is much to be wished that the whole could have been kept open, and preserved under a shed constructed of glass with iron supports; but the space required for increased bathing accommodation rendered the sacrifice too costly. If this could have been done Bath would then have possessed the finest collection of Roman remains, illustrative of Roman manners, and far surpassing any that have been found in Europe west of the Alps. Much controversy has arisen about the preservation of these remains, but we may feel assured that the city authorities will never neglect that which places this city far above other Roman-British cities, as none hitherto explored can show such perfect remains, constructed on so grand a scale. The stone of which the baths are built was taken from the quarries, still in use, at Combedown. The blocks used in the construction of the large bath are many of them 10 feet long, and are put together with the greatest care, the masonry being of the highest order. Six steps lead into the water from the platform which surrounds the bath, and this has three recesses on each side, which contained seats and accommodation for bathers. Large fragments of roofing, composed of wedged-shaped, hollow tiles, lie in the great bath and upon the platforms, showing the construction of the arched roofs that covered the buildings; and also fragments of sculpture which had adorned the edifice. The character of the masonry and the small remnants that remain of the ornamental work carry with them indications that these baths were constructed in the earliest portion of the Roman occupation of the island.

The work about the baths can be shown to be of successive dates, but the structure of the earliest and best portions may be carried back to the reigns of Vespasian and Titus, and may have been begun even earlier. Frontinus, who was Governor of Britain before Agricola, was known for his great work on aqueducts, which he constructed in Rome for supplying the city with water. It is not at all improbable that he, when Governor in Britain, may have recognised the value of the hot springs of Aquæ Solis, and given directions for their utilization. The structure of these fine works may have been planned by him, and carried out by his successors. We may therefore place them as early as the time of Vespasian, and not later than that of Hadrian.

Much more remains still to be discovered, as a fine hypocaust has been found near to the recently uncovered circular bath, and also smaller baths, apparently for private use. There can be but little doubt that these baths had originally all the accompaniments common to such structures, as may be seen in Rome, at Pompeii, and in the recently discovered Roman town at Herbord, in France, eighteen miles from Poitiers, and within a short distance of the small town of Sanxay. Here may be studied the complete arrangements of a Roman watering-place, as we have the baths, the temple, and the bathing establishment, all contiguous. We cannot but congratulate the city of Bath upon the possession of the remains recently laid open, indicating, as they do, the prosperity and former opulence of the city. It may have received marks of imperial favour, and been honoured at times by the residence of illustrious Romans.

(*To be continued.*)

BRITISH MEDICAL ASSOCIATION IN GLASGOW.

ABSTRACT OF AN ADDRESS BY SIR H. B. MACLEOD, M.D., "ON THE PROGRESS OF SURGERY DURING THE LAST HALF CENTURY."

SINCE 1837 all the collateral sciences on which medicine so largely leans have been in a great measure reconstructed, and the very foundations on which our art is built have been in no small measure relaid. In 1837 the doctrines of Broussais, which had been accepted with the enthusiasm of a revelation, and had deeply imbued the surgical as well as the medical practice of the day, had spent their force. Hahnemann and Brown, Gall and Spurzheim had come and gone with their disturbing influence, and men turned wearily from the discussion of mere doctrines and the dogmas of authority to a careful study, aided by experiment, of *facts*. Many remarkable discoveries in mechanical science, especially that of the achromatic microscope (1824 and subsequent years), the spectroscope, and the applications of electricity, powerfully contributed to the rapid progress of biology, morbid anatomy, pathology, and chemistry. In 1838 Henle and Mandl made known what their countrymen had then accomplished, and the members of the German school have ever since been the most enthusiastic and competent workers on these subjects.

The most distinguishing features of the period under review (1837 to 1887) have undoubtedly been anæsthetics and antiseptics. They are both "epoch-making" discoveries. Each has done almost as much for surgery as the discovery of hæmostatics, and when combined may, I think, be said to excel even steam and electricity in their gracious benefits to mankind. Though from the earliest times men sought for the means of allaying pain during operation, and numerous imperfect methods (as that of Dr. James Moore of this city, the younger brother of Sir John Moore, by compressing the nerves) had been tried to effect it, yet the statement of Velpeau, published in 1839, may be taken as expressing the opinion held seventeen years before the great discovery: "All research for an agent to destroy pain in operations is a mere chimera, and unworthy of further consideration." Suddenly, however, the riddle was solved by one who, recalling the experiments of Humphry Davy with nitrous oxide and sulphuric ether, dimly perceived the use they might be put to in surgery. Whatever credit in this matter may belong to the unfortunate Horace Wells, it was really Mr. Morton who worked out the practical application of ether, and in the theatre of the Boston Hospital may still be seen the sponge by which it was administered on that memorable October morning in 1846. After the abortive trial of various other agents chloroform was brought into use by Sir James Simpson, within a year of the time when attention was directed to the subject. This, the most valuable of anæsthetics, was discovered by Soubeiran in 1831, and had been shown to be a powerful anæsthetic by Flourens some years afterwards.

Local anæsthesia in its present form is also a conquest of the last half century, and though many agents possess this power, and some of them, like cocaine, are specially valuable for particular purposes, the finely divided ether spray introduced by Dr. Richardson (a distinguished student of the Glasgow school) in 1866, is more efficient and easy of application than any other for practical purposes. I need hardly say that anæsthesia has changed the whole face of surgery. "The lion heart" is no longer the requisite of a surgeon. Finesse and manipulative skill now take the place of force. Innumerable operations are rendered possible which could not before be attempted, and the surgeon has benefited almost as much as his patient.

There is no more interesting study in surgical history than the development of our present practice as regards wounds, from the blind groping of the surgeons of last century, to discover the secret enemy which baffled their best efforts, to the brilliant dawn which we have been permitted to see. The proper use and best form of deep and superficial stitches and dressings are also now well established, and the reign of dirty sponges and foul instruments and hands has passed away for ever. Modern pathology has put an end to the keen controversy which for 150 years bulked largely on surgical attention regarding purulent infection. The direct absorption doctrine of Boerhaave held the field to the middle of the eighteenth century, and was followed by the hydraulic, the metastatic, the spontaneous generation, the phlebitic (in various forms), and other theories, till Virchow (1846-56) threw a new light on the subject by his researches on thrombosis and embolism, after which the investigations on sepsin, blood ferment, and micro-organisms explained what was still unintelligible.

As a result of the misfortunes of the Crimean war, and to a less extent perhaps from the alarm caused by the cholera epidemic of 1852, the construction and organisation of hospitals and other public institutions have received more attention during the last twenty-five years than during the previous seventy-five which had elapsed since Tenon wrote.

Of the advances in doctrine and practice since 1837 much might be said. Not only has general anatomy been greatly advanced, but pathological anatomy has been created, while physiology has become a new and practical science under the influence of experiment. Chemistry has also been reconstructed. Experimental and microscopic research have elucidated in a remarkable manner the whole phenomena of inflammation and the febrile condition. The blood and its vessels, the reaction of the tissues involved, the part played by the nerves, the nature of the exudations, with their destinations and changes, as well as the growth, degeneration, and metamorphosis of structures, have all been laboriously studied by the aid of the microscope and by chemical processes. It was within the years 1838-39 that the cellular pathology was born. It took the scientific world by storm. Though no doubt it can be plausibly asserted that both John Hunter and Raspail dimly foreshadowed it, certain it is that Schleiden, Schwann, and Müller laid its true foundations, while Virchow and his pupils worked it out. Constant advance continues to be made by the use of new and improved methods of rerearch, so that our knowledge of the ultimate elements of the tissues is daily increasing. An immense scientific activity followed the year 1840. Within a few years almost all the tissues and organs and the secretions of the body, both in their normal and altered conditions, were laboriously studied, and the phenomena of the respiratory, digestive, and nervous systems, as well as the great subject of embryology, which throws so much light on congenital deformities, were largely investigated, and by none with more ability than by my late colleague, Professor Allen Thomson.

Within the last half century, and especially since the discovery of anæsthetics, all surgical operations have been greatly improved, and many new ones have come into use. The operator being no longer hurried, or his feelings harassed by the sufferings of his patient, and happily possessing better control of the result, is left free to plan and conduct his operation without embarrassment. In this progress of operative surgery amputation has largely shared. The improved methods of arresting bleeding, both during and after operation, have essentially contributed to its perfection. The indiarubber (1873), and more lately the spiral wire tourniquets of Esmarch, and the "bloodless" system, though now no longer carried out as at first practised, which these appliances rendered so easy of application, have been of the most eminent service in amputations and excisions, as well as in all operations on bones and deep structures. The old method of closing arteries by torsion—used by Galen and Avicenna, but more especially studied by Amussat in 1829—was much in vogue a few years ago; but it and acupressure—described by Heister and many others—which Sir James Simpson (1859) supposed would supersede all other hæmostatic methods, have been replaced by the antiseptic ligatures now in use. The modern practice of using water at a temperature from 120 degs. to 160 degs. F. for the arrest of oozing is in my experience admirable.

Excision of joints and resection of shafts of bone, now of daily performance, were by no means common at the time of the Queen's accession.

Within the half century aneurysm has been much studied in all its aspects, and its treatment has been simplified, though the methods of dealing with it have been greatly multiplied. It has been shown to be curable by the rapid coagulation of the contained blood, and not alone by the lamination of fibrin and contraction of the sac, a fact long denied; and this has suggested some of the most recent methods of dealing with it.

Pathological research has done much within the half century as to the large and important subject of new growths. Much, however, remains to be done. Since Muller, in 1838, brought neoplasms within the pale of the cellular pathology, and Virchow added so much to our knowledge, innumerable workers, aided by many new or improved mechanical contrivances and beautiful methods of preparing sections for microscopic examination, have turned their attention to the subject. A simpler classification and arrangement have resulted, with a better understanding of the clinical progress and results of tumours.

In no department of surgery has so much that is new and notable been achieved as in injuries and affections of the head. Much has been done, both by experiment and clinical observation, in the localisation of the phenomena of motion and sensation, and though much remains to be done which can only be cleared up by long and accurate research, still results have been garnered sufficient to give a confident hope that before long a complete and reliable map of the brain will be at the service of the practitioner. The brain areas which supply the face, the tongue, the limbs, and the muscles of respiration have been clearly defined by British and foreign physiologists. Clinical observations on man have supplemented experiments on animals, and already fruitful practical results have been obtained, so that the trephine has again come into use, but on far different grounds from those theoretical ones which guided its application at the beginning of the century. The first operation for the removal of a cerebral growth planned on the modern physiology was performed so recently as 1885. The new American perforator is much more precise and speedy than the old trephine, especially when worked by the "surgical engine," which has been invented for driving saws and perforators.

The galvano-cautery was first used in England by Professor Marshall in 1850, but to Middeldorpff of Breslau we chiefly owe its sytematic use in a large variety of surgical cases, where its rapid action, manageability, and the very light which it emits can be utilised. It can never, however, replace the knife for the mere division of structures, nor the actual cautery for counter-irritation in chronic inflammation. Electricity has made great advances as a practical agent since 1872. In experimental physiology, and as a diagnostic and curative agent, Erb's recent work will do much to promote its more precise use. To Duchenne (1855) must, however, belong the credit of having first recognised its importance; and it is probable that, with the aid of improved batteries and the modern "accumulator," better work will be done in the near future. Among the many ingenious and useful instruments for clinical research and demonstration, the ophthalmoscope stands pre-eminent. Foreshadowed by Babbage in 1847, its present important position in ophthalmic surgery is due to Von Helmholtz, who took it up in 1851, and with Ruete perfected it as a clinical instrument. To it we owe a knowledge of the pathology of the deeper structures of the eye, and the suggestion of various operations which have proved of the greatest service. The introduction of cocaine, since 1884, as a local anæsthetic, has added largely to the progress of ophthalmic surgery. The otoscope, the laryngoscope, and other similar instruments naturally followed on the construction of the opthalmoscope, and have been fruitful of good in their respective departments. The sphygmograph, made practically useful by Marey in 1860, realising the idea of Hales (1748) and of Herisson's sphygmometre, has largely aided the diagnosis of many conditions of the circulatory system and by its pictorial tracings secures permanent records of their variations. The sphygmophone, which professes to render the arterial sounds audible, is still of no practical use. The endoscope, which was much improved by Désormeaux, after 1853, has never attained a practical position, from the difficulty of using it, and the limited field to which it can be applied. Recently, however, Leiter, by using the smallest Edison lamp, and improving the construction, portability, and cost, has provided an endoscope which may possibly promote its employment. The thermometer, first used in medicine by Boerhaave and his pupil, De Haen, has become one of the most important clinical guides in consequence of the researches of Traube (1850), Wunderlich, and Zimmermann.

The beautiful discovery of skin-grafting by Reverdin, in 1869, provides us with a valuable resource in many difficult cases of delayed repair and deformity. The permanence of such grafts is not, however, as yet fully assured. The transplantation of periosteum, muscle, bone, nerve, and even eye tissues, has also been achieved of late years under the magic shield of aseptic surgery. Hydrophobia promises to be deprived of its terrors. Extensive burns are no longer dangerous when kept free from pollution, as the intestinal lesions which Curling drew attention to (1842) are now known to be due to septic poisoning. Nerves are stretched, with or without previous exposure, to the relief of many complaints;

nay more, divided nerves and tendons also are successfully united by suture. Thermal, chemical, and sea baths have their appropriate domain assigned them. Cod-liver oil and many concentrated foods, easy of assimilation and rendered more so by the addition of digestives, have come into use. Patients are no longer reduced by diet, purging, and bleeding, or blindly over-stimulated with alcohol, but a a dietary founded upon their requirements is prescribed before and after operation. The therapeutic advantages of change of scene and climate are fully taken advantage of, as the means of locomotion have been improved and cheapened. Of the innumerable new drugs with which chemistry has endowed us many highly valuable ones have come into general use, while greater concentration and more elegance have been employed in their manufacture. The surgical instrument maker has, by his ingenuity and skill, simplified and improved the surgical armamentarium, and for every purpose has supplemented our manual dexterity.

I have thus, in the limited time at my disposal, and to the best of my power, noted the changes and improvements in surgical theory and practice which have emerged during the last half century. The task I set myself has proved longer and more difficult than I anticipated, as the harvest has been extraordinarily abundant. I am conscious of having omitted much from want of time and knowledge; but I trust I have succeeded in showing that in every branch of the surgical art there has been a wondrous advance, and that the profession to which we belong marches in the very van of the great army, recruited in all climes, whose aim it is to enlarge human knowledge. Such a retrospect as I have attempted makes us reverence a profession whose hope and ambition it has ever been to abate suffering without distinction of race or creed. We see how an abiding and ever-increasing purpose has run through these long ages, and that while we now rejoice at being no longer bound by the authority and crude doctrines which shackled our forefathers, we can yet honour the traditions of the past, and appreciate the efforts of that great host of devoted men who have by their unselfish labours built up the famous temple of our art.

Visitors to Museums. — The Rev. H. H. Higgins divides such visitors into three classes: students, observers, and loungers. The students, who form, perhaps, 2 per cent. of the total, are those who go with a definite purpose, seeking the solutions of questions which have occurred to them during reading or reflection. The observers, who may range from 50 to 78 per cent., have no conscious definite object, but fix their attention with more or less intelligence on the specimens displayed, and generally carry some knowledge away with them. The loungers go to spend time, especially as the museums are places which "one must have seen." They are most numerous at South Kensington.

The Production of Iron.—According to *Dingler's Polytech. Journal*, the mean annual production of iron in the years 1880-1884, inclusive, has been, in Britain 4,275 kilos; in the United States, 4,674; in Belgium, 532; in Germany, 3,181; and in France 2,164 kilos. During these years the British production has been approximately stationary, that of Germany has increased nearly 30 per cent., and that of France by about 10 per cent. In Britain the maximum production was in 1883, but in America and France in 1882.

Abstracts of Papers, Lectures, etc.

JUNIOR ENGINEERING SOCIETY.

On the 20th ult. a number of members of this Society visited the Hampton and Kew Bridge stations of the Grand Junction Water Works, through the kindness of Mr. Fraser, engineer to the works. At the Hampton station an explanation was given of the two systems in operation there, viz., one for supplying London direct with 800,000 to 1 million gallons of filtered water hourly, and the other for passing 17 million gallons of unfiltered water a day on to Kew. The engines, pumps, boilers, etc., having been seen, the party proceeded outside to the reservoirs and filter beds, one of which latter being in course of reconstruction, the different layers of filtering material and culverts were fortunately all exposed to view. The Kew Bridge station is arranged to filter the water received from Hampton, and also to filter about 600,000 gallons per hour, drawn direct from the river. The pumps raise both supplies to a head of 150 feet. The filter beds and reservoirs at Kew are on a larger scale than those at Hampton, and the manager gave an interesting explanation of the different operations involved in charging, emptying, cleaning, and maintaining them. The engines, pumps, etc., here also proved of considerable interest.

A visit to the works of the Southwark and City of London Subway took place on the 27th ult., Mr. Greathead, Engineer to the Company, having kindly granted the necessary permission. The party met at the Harleyford Street workings, Kennington Park, and after descending the shaft where the passenger lifts will be fitted, walked down one of the tunnels, which are 10 feet in diameter, to the working face. Here the resident engineer fully explained the ingenious arrangements devised for driving the tunnel; setting the segments of the cast-iron rings composing it; and for filling with grouting of blue lias lime the small annular space left between the tunnel cutting and lining. This last highly important detail of the construction is successfully effected by forcing the mixture by atmospheric pressure through the holes left for the purpose in each segment. A vote of thanks was accorded to Mr. Greathead and the resident engineer at the conclusion of the visit.

THE CAMBRIAN ARCHÆOLOGICAL ASSOCIATION.

The forty-third annual congress of the Welsh Archæological Association was opened by the Bishop of Llandaff, the president-elect, on the 13th inst., at the Town Hall, Cowbridge, who expressed the hope that the visit would furnish them with ample materials for archæological study. Among the various objects of antiquity which were to be found within easy distance of their present place of meeting there were some which would serve to call their thoughts back to the time when the Druids worshipped with their intricate and it was feared too often cruel system in temples which consisted of nothing more than a collection of colossal stones untouched by the hammer or chisel of the workman, while at other spots would be found remains more or less perfect of the grand old abbey or more modest parish church, in which the varying styles of Christian architecture followed each other in succession, each in its own peculiar gracefulness and beauty. Referring to the most ancient or British period, perhaps the most interesting monument within the verge of their present resources was the vast cromlech near Duffryn, in the parish of St. Nicholas. It was, he believed, one of the largest, if not the largest, of the Druidical remains to be found in the kingdom. Other remains of the same period, devoted to the same object but of smaller dimensions, existed in the immediate neighbourhood. But the remains of the British period still in existence were not confined to those of structures devoted to religious purposes. Encampments of greater or less extent, scattered at intervals over large portions of the land of Morgan, served to remind them that their forefathers were not so wholly engrossed in peaceful pursuits as to neglect to guard themselves against the attacks of their enemies. Passing from the British period to the Roman occupation, which commenced about the middle of the first century of the Christian era by the victory of the Roman general over Caractacus, he remarked that doubtless at the moment the conquest of the British and the captivity of their brave leader were regarded as a terrible national disaster; but by God's providence that event was productive of the holiest blessing which our land had ever inherited in the first planting of Christianity within its borders, and the seed out of which first sprang the ancient British Church, which from that day to this, notwithstanding many trials, had been continued in unbroken continuity during the past eighteen centuries. But apart from the interest which attached to the introduction of Christianity into Britain, regarded in its religious aspect, in some at least of its results it had a peculiar interest for the archæologist, since there were few objects which he investigated with greater pleasure and satisfaction than the remains of those ancient Christian temples which were raised by our pious forefathers to God's honour and glory. His lordship proceeded to notice some of these remains which were more immediately connected with the advent of the Romans, and then passed on to remark that the period that followed the departure of the Romans had few objects of interest for the archæologist. The northern invaders' rule was unlike that of the Romans and provoked a more obstinate and prolonged resistance. The results of this were still to be seen in the remains of the many Norman and English castles which abounded in that and the neighbouring counties of South Wales, and which furnished for the archæologist some of the most interesting objects of research. Many of the parish churches, he added, would be found interesting on account of their peculiar construction and the various styles of architecture; and he particularly referred to the Church of St. Iltyd, or Lantwit-Major. He also alluded to some recent discoveries at Cardiff Castle, and expressed his best wishes for the success of the present Congress.

Mr. E. Laws then read a paper on "The Black Friars of Cardiff."

On Tuesday morning the members started by road for St. Hilary, Old Beaupre, St. Athans, Fonmon, Penmark, Llancarvan, and Llantrithyd. It was a beautiful summer day and the scenic attractions of the country were much enjoyed. One of the first objects of the excursion was Beauper Castle, as it was originally written, which supplies an example of the classic style of architecture engrafted on the Gothic, and where the remains of an ancient Welsh fortress may be traced. The Castle of Fonmon is a large Norman structure, one of the class referred to by the Bishop of Llandaff in his inaugural address, but long since modernised and adapted for present occupation.

In the evening the following papers were read:—On "English and Welsh Law in the Marches;" on "The Norwich Taxation and Diocese of Llandaff," by Archdeacon Thomas; and on "The Manor of Llanblithian," by Mr. J. A. Corbett.

The members on Wednesday visited the ancient village of St. Bride's Major, and afterwards inspected Ewenny Abbey, the residence of the Turberville family, a Benedictine priory, founded early in the twelfth century by William de Londres and his son Maurice. The priory contains some of the finest Norman work in Wales. A meeting was held at Cowbridge Town Hall in the evening, under the presidency of the Bishop of Llandaff, when Mr. Stephen Williams read an interesting paper on "The Recent Excavations at Strata Florida Abbey."

On Thursday an old fortified town was first visited under the guidance of Mr. Thomas Rees, the Mayor, and Mr. Iltyd B. Nicholl, F.S.A. The ruins of St. Quintin's Castle were afterwards inspected, and a visit was paid to Llanmihangel-place and Llantwit-Major, where the ancient monastery was, according to tradition, founded by Garmain (St. Germanus), Bishop of Auxerre, during one of his visits to Britain to counteract the spread of Pelagianism. The village of Marcross and the historic St. Donat's Castle were next visited. In the seventeenth century Archbishop Usher took refuge in the castle, and remained there some months after the collapse of the royal cause at Naseby. The site known as Caer Wrgan, on which the Cardiff Naturalist Society have made some excavations, was examined, and the inscribed crosses of Llantwit-Major were described on the spot by Mr. J. G. Allen, F.S.A. In the evening a paper was read by Mr. Edward Lawson on "St. Fagan's Fight."

WILTSHIRE ARCHÆOLOGICAL SOCIETY.

The annual meeting of the Wiltshire Archæological and Natural History Society opened on Aug. 7th at the Town Hall, Calne. The Rev. Archdeacon Buchanan presided.

The Rev. A. C. Smith (one of the general hon. secretaries) read the annual report, of which the following is an abstract:—The committee recorded steady progress, the number of names on the books being 363, an increase of thirteen during the year. They deplored the death of nine members, including their valued curator, Mr. Henry Cannington. The balance-sheet showed, on Dec. 31st, a balance of £195 13s. 5d., but a large portion of it would soon be absorbed in defraying the cost of publications which the society had in hand. The society had made a divergence in the direction of publishing a large octavo volume of 512 pages on the flowering plants of Wiltshire, for which it had secured the services of the Rev. T. A. Preston. That volume the society hoped to present to members in the course of a few days. The museum and library had received additions by donations of various sorts and from various quarters. In the work of the society afield they had very important matter to communicate, for, in the extreme south of the county, excavations on a large scale had been made this spring by General Pitt-Rivers, and sections of considerable dimensions had been cut, under the immediate direction of that experienced archæologist, in one of the old boundary ditches, known as "Bokerley Dyke."

It had been generally believed by the great majority of Wiltshire archæologists that Bokerley Dyke, together with its fellows, "Grims Dyke," in the south of Salisbury, "Old Dyke," which runs over Salisbury Plain to the north of Heytesbury, and their own "Wansdyke," in the immediate neighbourhood, were—whatever might have been their object and whoever their authors—at any rate of pre-historic date; that, whether they were the work of the early Britons, the Celts, or the Belgæ, they were at all events pre-Roman. But now, in removing a considerable portion of the bank at Bokerley Dyke, and exposing the original surface on which the excavated soil had been placed, General Pitt-Rivers had come upon large quantities of Roman pottery and several hundred Roman coins of a late date. This was evidence which, however unpalatable to some of them, could not be gainsaid, and they might take it as proved that Bokerley Dyke, which Canon James, when writing on the subject, considered to be the oldest of the Wiltshire dykes, and whose date he attributed to some two or three centuries before the Christian era, must henceforth be allowed to be of late Roman, if not of earlier times. They must say all honour to General Pitt-Rivers, who had set at rest for ever the question of date with regard to Bokerley Dyke. In conclusion, the report pointed out that a vast amount of material still remained for the careful examination of the members of the society in all parts of the county. The committee trusted that as the older members dropped off, younger and more active workers would come forward to take their places, because they were well assured that continual and prolonged efforts must be made before they could claim to have in any degree mastered the ancient and natural history of Wiltshire.

In the evening the anniversary dinner of the society took place at the Town Hall, after which a conversazione was held, when papers were read by the Rev. Canon Jackson on "Calne"; and by the Rev. W. C. Piender-leath on "Cherhill Gleanings."

INTERCEPTING TELEGRAMS.—The Austrian War Office is stated to be paying great attention to a matter which is of the greatest importance in the use of the telegraph in the field. It has been ascertained that the telephone is so acute of hearing that before it every secrecy of telegraphing disappears. If, formerly, it was desired to ascertain the secrets of the telegraph wire the latter had to be cut and an apparatus inserted. Now, with the help of the telephone, all telegrams may be read easily, even from a considerable distance. It is only necessary to carry a telegraph wire of moderate length parallel to the original line, and insert in it a telephone, from which the Morse signs may be read off by ear. This would, of course, be very awkward in the case of war telegrams. The question has naturally arisen how this difficulty is to be met. The problem is solved in a surprisingly simple manner by Herr Heinrich Discher, who proposes cross telegraphing for the purpose. He says that if telegrams are sent from opposite directions on the same wire at the same time, the listener at the telephone only hears a medley of confused sounds. In practice the matter may be dealt with in the following manner:—One station sends actual telegrams, the other a despatch previously agreed upon. As long as the operator at the former station sees this despatch coming in, he may make sure that no eavesdropperis able to read the telegram he is sending.—*Times.*

CORRESPONDENCE.

The Editor does not hold himself responsible for opinions expressed by his correspondents, nor can he take notice of anonymous communications. All letters must be accompanied by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

FORMATION OF ICE.

I should like to offer for the consideration and criticism of your readers the following idea as to the possible formation of ice. I do not know if it has occurred to any one before, and I may perhaps be saying nothing new. We know that water at ordinary temperatures, say 45° F., will contract if the temperature be lowered to about 39° F. This is to be explained by the molecules of water being separated by interspaces, as shown to exist by the experiment of dissolving a certain amount of powdered sugar in it, without the bulk of water being increased. As soon, however, as 39° is reached, or thereabouts, water begins to expand until it is converted into ice at 32° F.

Now, whenever water freezes, it does not solidify into a mass of accurately fitting crystals, like rhombs of calc-spar, which have no interspaces, but always in "macles" or compound forms, so well seen in a flake of snow; and these necessitate an abundance of interspaces. Although a block of ice *appears* to be perfectly homogeneous, like a block of transparent Iceland spar or rock crystal, yet, as Prof. Tyndall showed many years ago, by transmitting a beam of electric light through it, it immediately revealed its anatomical structure; it is really composed of myriads of "ice-flowers."

Hence my idea or theory is that at 39° F. the molecules of water *begin to arrange themselves into lines always intersecting each other at an angle of* 30°, and as soon as 32° F. is reached, they become revealed to our senses as solid ice.

This arrangement of the molecules into macles necessitates "re-entering" angles and angular interspaces. Consequently, bulk for bulk, a block of ice must be greater than that of the body of water which composed it.

This at the same time accounts for the decrease of the specific gravity, in as much as air must constitute a certain portion of the block of ice.

As pure, transparent glacier ice is nothing but compressed and consolidated *snow* aided by re-gelation, so, I take it, a block of lake ice is of exactly the same construction, though it be *water* directly frozen.

Bismuth is well known to be another substance which imitates ice in expanding when crystallised, and since the crystals of bismuth are also compound, and incapable of "fitting exactly" in the mass, a like interpretation will apply to it.

I should be glad to hear what any physicist or other reader may have to say to the above. GEORGE HENSLOW.

PETALS OF THE WHITE JASMINE.

Taking up a spray of this shrub, covered with blossom, I noticed that some of the flowers had four petals each, some five, and others six. I could see no indication that those with four petals had lost one or more. I therefore take the liberty of asking you or your readers if such variations are common, and, if so, what is supposed to be the cause.

SCRUTINY.

TENNYSON AS AN OBSERVER.

In your number for July 20th (p. 50) you give some instances of an accuracy of observation on the part of Laureate rarely to be met with among poets. However, cases of an opposite kind are not altogether wanting. Thus we read:

"Heavily hangs the broad sunflower
Over its grave in the earth so chilly;
Heavily hangs the hollyhock,
Heavily hangs the tiger lily."

The hanging or drooping of the sunflower, as its seeds are ripening, is a well-known fact. But the hollyhock presents nothing similar.

From the first appearance of the bud to the maturity of the seed, the flower of the hollyhock never hangs or droops, but remains pointing slightly upwards.

Browning, in the verses quoted, is astray in saying: "The bee with *his* comb." Accuracy requires "*her*," since the male bees are not let live through the winter.

AMPHION.

PECULIAR WATER.

In an old book I lately met with an account of a river in Corsica named Restonice, the waters of which are said to blanch every object placed in them. The elder Darwin (Erasmus) states that iron laid in this river for a few days looks as if plated with fine silver. At the same time the water is said to be "perfectly wholesome and clear as crystal." I should be glad if you, or any of your correspondents could tell me if these statements are founded on fact, and if so, what is their explanation? SEPTIMUS.

DYE COLOURS FROM PLANTS AND SHRUBS.

Under this title you give a paragraph (p. 28) on dyes obtained from "very common plants." But it is well to remember that these colours cannot compete either in permanence or in price with those now recognised in our dye-works. The colours obtained from elder-berries, blue-berries, etc., are sadly lacking both in fastness and lustre, and they have, therefore, been almost universally thrown aside.

PATTERN-DYER.

COBRAS.

The enclosed cutting from the *Homeward Mail* may be of interest in reference to your article on Cobras, in the SCIENTIFIC NEWS of the 10th of August. There is certainly a strong impression amongst the natives of Southern India that cobras entertain feelings of revenge against those who injure them, and I well remember on one occasion being told of an incident similar to that related in the paper, when a cobra, which had been attacked but had escaped, returned during the night and bit the man who had assailed it, with fatal results. G. G.

Grindelwald, Switzerland.

"A COBRA'S REVENGE.

"The death of Mr. Andrew Fischer, an employé of the Madras Railway Company, at the Pennar Bridge Works, on the north-west line of the railway, under most distressing circumstances, is reported. He was employed as a driver of bridge engines at the Pennar Works. While he was seated in the verandah of his bungalow he observed two large cobras on the barren plain immediately in front of the house. Arming himself with a stout stick, he proceeded to the spot and encountered the snakes. He succeeded in killing one of them, while the other, which had been slightly wounded, managed to escape. Mr. Fischer hunted about for the runaway, but could not find it. He then returned to his bungalow and rested for some time, as he was off duty. Later in the day he prepared to go to his work, and with that object got out his clothes to dress. He sat on his coat, and was about to put on his shirt when he felt something sting him on the back. He turned round, and to his horror found a snake on the cot behind him, which he is said to have recognised as the cobra he had wounded that morning. He immediately sought medical relief, and all kinds of remedies were applied, but to no effect, and he died in the evening, leaving a widow and an infant child, for whom much sympathy is felt.

"'Kellayan' writes to a Bombay paper, 'It is commonly believed among the Hindoos that no animal is more revengeful than the cobra, and that if an attempt is made to kill it, and it escapes, it never gives itself rest until it has wreaked its vengeance upon its assailant. This conviction is very widely shared by intelligent people. A particular friend of mine, now holding a very important position in Vizianagram, an M.A. and a B.L., used solemnly to tell me that this craving for vengeance on the part of cobras and alligators is not a mere figment of the fancy. Taking for granted that the facts about Mr. Fischer's death are as they are stated to be, will any of your scientific readers explain whether there is any truth in the popular belief that cobras trace at all hazards the whereabouts of their assailants, and do nothing until they have revenged the injury done or intended to be done to them? I am also informed that failing in the object of their attempt, they cease to live.'"

SPARROW HAWK (*ACCIPITER NISUS*) AND KESTREL (*FALCO TINNUNCULUS*).

I am now going to call the attention of those interested in oology to a curious circumstance to which my attention was called by my young friend, Mr. H. Jonas, *i.e.*, that the sparrow hawk and the kestrel lay their eggs in pairs. I do not intend to say that they are exactly alike, but sufficiently so to see that in a full clutch of six eggs there are three pairs; if five eggs only, then two pairs and one odd egg. Since my attention was called to this fact, I have pretty well ascertained that with the sparrow hawk the first pair laid are generally blotched or marked over the large end, the second pair marked at the smaller end, the other spotted or marked more or less all over. With the kestrel the colouring is not blotched, but it varies in intensity. I have some good clutches showing this peculiarity, and I should be glad if any collectors of eggs reading these notes will be good enough to give me any information they can upon this point.

If the recuperative power in birds was not exceedingly great, many of our birds would soon become extinct, as their enemies may be reckoned from the hand of man down to the creeping things of the earth. I will here mention some of the enemies: first of all, the boys, who take the eggs and young for the amusement of breaking the eggs and killing the young birds; then the birds of prey, followed by such birds as the raven, crow, jackdaw, rook, magpie, jay, and perhaps some others; then the foxes, cats, polecats, stoats, weasels, rats, mice, moles, hedgehogs, snakes, and snails. I do not accuse the latter of killing and eating birds, but they get into their nests and crush the eggs. The ordinary agricultural operations, such as cutting hay, ploughing, etc., destroy a vast number of eggs and young, partridges, larks, and corn buntings being the greatest sufferers. But of all their enemies the long-eared owls and the cats are their worst. The domestic cat (?)—save the mark!—when in the fields at night, is, in proportion to its size, as savage and relentless as the largest Bengal tiger. If these domestic pets are not shut up at night during the breeding season, they stray into the fields and make sad havoc with the partridges, and, like the tiger, where they make "a kill" one night they are almost certain to return the following night; they climb trees and take the young from the nests even at a very considerable height from the ground; in fact, a nest is not safe unless it is so placed to be quite inaccessible to the aforesaid domestic beast.

I cannot close these notes without adding a word or two in self-justification for having such a large number of the eggs of the common sparrow in my possession; but had I not preserved them, they would only have been trodden under foot, leaving me nothing to corroborate some of my statements. JOSEPH P. NUNN.

Royston, August 7th, 1888.

FERTILISATION OF FLOWERS.

I shall be glad if your readers can inform me how the flowers of the evening primrose and sweet-scented tobacco are fertilised. I have them growing in my garden, and frequently visit them after dark, when they are fully expanded, but have not noticed insects visiting them. L. H. A.

Chiswick.

UNUSUAL RAINFALL.—The rainfall registered at Grays, Essex, for the twenty-four hours ending 8 a.m., August 2nd, was 5·3 inches, which is a fact probably without a parallel in the meteorological records of this country. This quantity represents 119,859 gallons, or 535½ tons of water per acre.

RECENT INVENTIONS.

The following list has been compiled especially for the SCIENTIFIC NEWS *by Messrs.* W. P. THOMPSON *and* BOULT, *Patent Agents, of* 323, *High Holborn, London, W.C.; Newcastle Chambers, Angel Row, Nottingham; Ducie Buildings, Bank Street, Manchester; and* 6, *Lord Street, Liverpool.*

MECHANICAL TOY.—A mechanical toy has been patented by Mr. G. Cole. The invention relates to mechanical toys, in which a horizontal wheel, mounted in a suitable frame, is made to rotate by the revolving of an ordinary spinning top, by the former being so placed over the cup in which the top is spun that the spike of the latter is automatically brought in contact with the disc, causing it to revolve.

PROMOTING CIRCULATION.—Means for promoting circulation of blood in a living body has been patented by Mr. E. Black, and consists in enclosing the affected part of the body in a case which is so arranged that the air in it can be partially exhausted. This exhaustion causes the blood to flow to the part under operation; after this has taken place the exhaustion is stopped, and the air is allowed to again enter the case, thus allowing the blood to flow back again in the ordinary course.

SECONDARY BATTERIES.—A secondary battery has been patented by Mr. H. Mower. The support for the active material is in the form of a grid, the bent over ends of which are joined by a portion of the same strip. The spaces between the supporting strip are filled in with the active material, which is mixed with hair to give it coherence. One or more spaces are left open which allow of the plate contracting and expanding more equally without the active material becoming disintegrated and falling therefrom. At the corners are projections to keep the plates in position and shape when in the cells.

INDICATOR.—An indicator for vehicles has been patented by Mr. J. R. Lawrence. This invention is to provide means for indicating to the driver of a vehicle when the vehicle immediately in front is about to stop. This indicator is hinged to one side of the rear of the vehicle in such a way that when out of use it lies flat against the side of the vehicle, and is thus held by a spring. When the vehicle is stopping the brake is applied, which turns the signal out at right angles to the side by a rod pivotted to its inner end, and connected to receiving an endway movement from the brake by means of a bell-crank lever.

MINER'S LAMP.—Mr. J. Ashworth has patented a miner's safety lamp to enable greater control to be had over the wick flame when fire-damp explodes within the lamp. Around the reservoir is placed a perpendicular flanged ring, in which are air holes. The air is thus directed against the flame, and produces better combustion and illuminating power. The top of the oil chamber is covered with a non-conducting substance. The sieve ring carrying the gauze, through which air is admitted to the combustion chamber, is formed with a rectangular groove with holes bored through it, thus increasing the area for the admission of air.

GYMNASTICS.—A gymnastic apparatus has been patented by Mr. R. Parke. This apparatus is for expanding the chest and straightening the shoulders, and consists of a footboard placed on the ground and marked to show the positions in which the feet are to be placed. Two poles are provided having weighted knobs on top, the bottoms being formed to pass into holes in the board, one on each side of the user. The user places the poles in position, standing in the marked position and grasping the poles at any convenient height. By working the arms in an outstretched position towards the back, still holding the holes, the weighted ends throw back the shoulders, and thus expand the chest.

VENT PEG.—An automatic vent peg has been patented by Mr. C. Wayte. This peg is constructed of a hollow metal cone, the diameter and taper being the same as ordinarily, but the cone is shorter and slit downwards from the top in three of four places, so that when the upper part of the cone, which projects beyond the cask after the cone has been driven in, is laid over upon and level with the cask, the slit portions of the cone can be used for extracting the peg by means of pliers; over the smaller end of the cone is placed a piece of elastic tube, having five or six incisions, and made air-tight at its end. A piece of wire long enough to enter the small end of cone is introduced into the elastic tube, thus forming a valve which allows air to enter the cask when required, and prevent the escape of liquid when the cask is rolled. The pressure within the cask causes the incisions to close up round the wire inside the tube.

PREVENTING COLLISIONS.—A method of preventing collisions at sea has been patented by Mr. L. Somzée. The invention consists in transmitting electric currents from one vessel to another by means of the water for actuating signals and also in means actuated by the current which stops the way of the vessel. For operating the signals at a distance powerful sources of electricity are placed on the vessels, communicating with two electrodes placed in the water, so that should another vessel provided with these devices approach, the resistance between the electrodes of the different vessels will be less than that between the electrodes of the same vessel; at this moment a current will pass from one vessel to the other, and the signals will be sounded. The currents passing from vessel to vessel act upon electro-magnets, causing them to set in action mechanical devices for stopping the ship or changing its course.

ELECTRICAL SIGNALS.—An apparatus for transmitting and receiving electrical signals has been patented by Mr. T. A. Garrett. The required current is produced in the transmitting instrument by electro magnetic induction. Pieces of iron have an oscillatory motion imparted to them by means of a spring made to vibrate by being moved out of the ordinary position and then set free. The pieces of iron thus cause stationary iron cores to be magnetised and demagnetised successively in the same direction, and round these cores are wound coils of wire in electrical connection with the line, so that the movements of the pieces of iron cause currents in the line alternately in opposite directions. In the receiving instrument pieces of iron attached to springs are vibrated by currents which pass through the lines, and also through stationary coils of wire. The pieces of iron are inductively magnetised by fixed permanent magnets, and are moved alternately in opposite directions by th currents in the lines and fixed magnets.

SELECTED BOOKS.

Handbook of the Amaryllideæ. Including the Alstrœmerieæ and Agaveæ. By J. G. Baker, F.R.S., F.L.S., First Assistant in the Herbarium of the Royal Gardens, Kew. London: Bell and Co. Price 5s.

Electro-Plating. A Practical Handbook on the Deposition of Copper, Silver, Nickel, Gold, Aluminium, Brass, Platinum, etc., with descriptions of the Chemicals, Materials, Batteries, and Dynamo Machines used in the Art. By J. W. Urquhart, C.E. Second Edition. London: Crosby, Lockwood and Sons. Price 5s.

NOTICES.

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METEOROLOGICAL RETURNS

For the ten weeks ending on Monday, August 13th, 1888. Specially prepared for SCIENTIFIC NEWS from official reports.

	Mean Temperature.	Rainfall.	Duration of Sunshine.
Scotland, East	54·0 degs., being 3·8 degs. below average.	7·0 ins., being 0·7 ins. above average.	361 hrs., being 22 hrs. below average.
England, N.E.	53·7 " " 4·2 " " "	8·3 " " 2·7 " " "	269 " " 108 " " "
England, East	57·1 " " 3·5 " " "	8·3 " " 2·9 " " "	303 " " 149 " " "
Midlands ...	56·1 " " 3·6 " " "	8·0 " " 2·4 " " "	250 " " 107 " " "
England, South	56·6 " " 2·8 " " "	8·5 " " 3·7 " " "	289 " " 153 " " "
Scotland, West	54·8 " " 1·6 " " "	9·5 " " 1·8 " " "	361 " " 36 " " "
England, N.W.	55·7 " " 3·2 " " "	9·4 " " 1·7 " " "	324 " " 66 " " "
England, S.W.	56·6 " " 2·9 " " "	9·4 " " 2·2 " " "	349 " " 118 " " "
Ireland, North	55·1 " " 2·7 " " "	11·9 " " 3·8 " " "	324 " " 13 " above "
Ireland, South	56·6 " " 1·9 " " "	9·6 " " 2·9 " " "	358 " " 7 " below "
The Kingdom...	55·6 " " 3·0 " " "	9·0 " " 2·5 " " "	3[illegible]9 " " 75 " " "

The highest temperatures as yet this year were reported during the last week of above period, namely, 85 degrees, at both London and Cambridge.

Scientific News

FOR GENERAL READERS.

Vol. II. FRIDAY, AUGUST 31st, 1888. No. 9.

CONTENTS.

SCIENTIFIC TABLE TALK.

By W. Mattieu Williams, F.R.A.S., F.C.S.

I am glad to see that the subject of glaciation was taken up in Scientific News of August 10th for two reasons—first, because the work done by glaciers in determining the distribution of the materials and the configuration of the present surface of the globe is so great; and, secondly, because the phenomena are on the surface within reach of all, thus affording opportunities of direct study to anybody and everybody, with a minimum of technical preparation. Other departments of geology demand a knowledge of mineralogy and palæontology, besides sections and appliances. Once acquainted with the characteristic vestiges of glaciation, they may be broadly observed from the windows of an express railway train or the deck of a coasting steam-packet, and a collection of their most interesting details may be made by carrying no other appliances than a few sheets of paper and a piece of shoemakers' heel-ball.

In England, north of Finchley, in all parts of Scotland and Ireland, and throughout middle and northern Europe and America, vestiges of ancient glaciers abound.

I had the good fortune to be started early in the practical study of the subject by attending the natural history course of Professor Jamieson in the University of Edinburgh in 1841.

He was then a very old man, the last of the Wernerian school, and very conservative; nevertheless he took up this subject with exceptional enthusiasm, although it was then an innovation. In the following summer I spent a day with Agassiz in his "Hotel des Neufchatelois," a wooden shed built on a great boulder that was floating on the Aar glacier. Here he spent his summer holidays in company with a jovial band of students, and collected the greater part of the material of his classic treatise, "Etudes sur les Glaciers," which was published at Neufchatel in 1840, and supplied Jamieson with the material of his lectures in 1841.

In order to obtain sound ideas concerning glaciation, we must first understand clearly what a glacier really is. It is not sufficient to know that it is "a sea of ice;" we must understand the difference between a true glacier and a mere accumulation of compressed snow, and the conditions upon which the formation of true glaciers depend.

We know what becomes of the redundant rain which falls on the tops and sides of hill and mountains that do not reach the snow line. It runs down their slopes in rills and torrents, forming a river in the valley below, which gathers as it flows more and more of such contributions, and finally pours them all into the sea. Broadly speaking, every valley is, at its lowest part, the bed of a river, or of a lake which is simply an outspread river.

But when we rise above the snow-line we come upon a region of solid precipitation, where the water that falls from the clouds is solid crystallised water, is snow; the height of the snow-line being that at which the annual thawing work just balances the total snow-fall of the year. Above this the total snow-fall of each year exceeds each year's thawing. Therefore, above this, there must be continual accumulation.

What becomes of such accumulation?

A full reply to this question tells the whole story of the origin, distribution, and movement of glaciers, as well as of icebergs and avalanches. I will only attempt a reply in condensed summary.

It is evident that if we had a mountain shaped as a symmetrical cone, with its apex far above the snow-line, the accumulation of snow would be piled up until the slope of its sides exceeded that of the angle of repose for such material, and then it would slide down in the form of avalanches.

The same would occur on a long symmetrical unbroken ridge of mountain. But such unbroken symmetry, even if it existed at first, would be destroyed by these avalanches. They would furrow the slopes in the course of their downsliding.

As a matter of existing fact all ordinary mountains are thus furrowed, and usually very deeply. It is evident that such furrows must determine the course of overflow of the accumulating snow. It is also a matter of existing fact that all such furrows or steep lateral valleys running downwards from great super-snow-line regions or *nevé* (as they are named in Switzerland) are either the beds of glaciers, or dangerous regions visited occasionally by avalanches and avoided accordingly.

Why should one such valley be an avalanche track, and another be occupied by a glacier?

This is a question that is rarely asked or answered, although instances abound of such discrepant valleys lying side by side, and both communicating with the same *nevé*. Thoughtful observation of such discrepancies presents a solution of the problem.

The avalanche valleys widen downwards, those which are filled with glacier ice are narrower below. In a few rare cases a dam or barrier of rock does the work of general narrowing.

The effect of such narrowing of a trough or valley outlet of the snow is easily understood. An avalanche falling down a widening furrow or valley is outspread as it descends, and thereby exposes a large surface to the summer sun; that falling into a narrowing furrow lodges and accumulates in a thick heap below, which may or may not, according to its quantity, be able to resist the summer thawing. If not, it disappears in the autumn, to be replaced next year by a similar evanescent accumulation.

If, however, the quantity is greater than the summer sun can thaw, more or less remains; to this is added the next year's accumulation, and so on until the valley is filled, and its contents become continuous with the *nevé* above. Then a true glacier is completed, which thereafter flows downwards in a continuous stream of apparently solid, but actually semi-fluid or viscous, ice, displaying in its course a series of most interesting phenomena due to the exposure of a large mass of ice that has descended far below the snow line, and is consequently in a state of continuous thaw during the summer days, and is continuously replenished by silent and invisible downflow from above.

My attention was first directed to the birth-history of glaciers in the course of a walk up the Romsdal, by observing that in nearly all the breaks and hollows of the Troltinderne there were patches of snow, some of them so low as almost to touch the oat-fields. I was puzzled by their position, only a few hundred feet above the sea in the latter part of summer, and with a nearly south aspect, but presently I observed that some of the multitude of distant cascades were temporary; further observation showed that they were not waterfalls as I first supposed, but snowfalls, that suddenly ceased, and were followed by a low thunderous rumble that settled the question of their composition. Below all these were patches or pockets of snow that only required a sufficient supply from above to become full-grown glaciers, and from which actual glaciers will ultimately become evolved, if the present conditions remain long enough, for these small avalanches have visibly rasped and smoothed and deepened the gully down which they fall, and are thereby continually deepening and narrowing it, while at the same time enlarging the upper outlet by their aid to ordinary frost and thaw weathering.

Another lesson may here be learned, viz., that a series of avalanches may do the work of smoothing, and grooving, and striation, and moraine heaping, usually ascribed without discrimination—even by our best geologists—to glaciers.

I described these in "Through Norway with a Knapsack," chapter x. In Tönsberg's "Illustrated Handbook," published sixteen years later, is a picture of the Troltinderne, showing some of the low snow patches and a large outspreading avalanche talus.

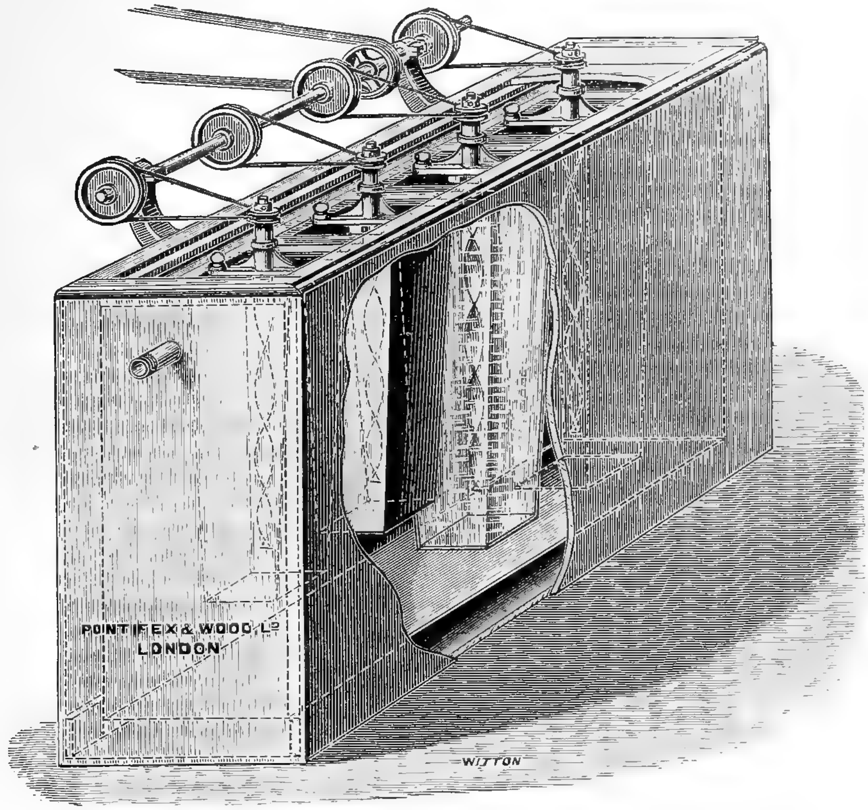
ICE-MAKING MACHINE.

REFRIGERATING machines are now very largely used for preserving meat and other articles of food, for cooling or regulating the temperature of air or water, for the production of ice, and for many other industrial purposes. In the steamships which convey meat from Australia, New Zealand, and other countries, the refrigerators are nearly always kept at a low temperature by means of air pumps, the cold being produced by the expansion of the air previously compressed. Ammonia and ether are also used, as they vapourise under the ordinary atmospheric pressure at a low temperature, and in the process of vapourising a large amount of heat is rendered latent, and thus cold is produced. Ether is, however, more troublesome to deal with, and its use is attended with greater expense, so that ammonia is more generally adopted. There are machines in which ammonia gas is compressed mechanically into the liquid state, and this liquid ammonia is afterwards vapourised so as to produce a low temperature. Another system, much used by brewers and others, is to obtain the required anhydrous liquid ammonia from the ammoniacal liquor of commerce, by the application of heat and subsequent condensation.

It is on this principle that the well-known refrigerating machine made by Messrs. Pontifex and Wood is worked. In a strong horizontal cylinder or generator a charge of the ammoniacal liquor of commerce is placed. In this cylinder there is a coil of piping through which steam is passed, and the ammonia is driven off by the heat of the steam. The ammonia then passes through a separator, in which any vapour of water which rises with it is condensed and returned to the generator. From the separator the ammonia gas is conveyed to a condenser, consisting of a cylinder containing a coil of piping through which there is a circulation of cold water. In this condenser the ammonia is condensed into the liquid form, and this liquid ammonia is then passed into another cylinder, called a cooler. When it enters the cooler the liquid ammonia has a temperature of 70° to 80° F., and it is then allowed to expand into the gaseous form. In doing so its sensible heat is rendered latent, and its temperature is usually reduced to about 10° or 20° F., say 22 to 12 degrees below freezing. In the cooler there is a coil of piping, through which water or brine is circulated, and the expanding ammonia gas cools this water or brine down to any required temperature. When the ammonia has expanded, it has done all the work of cooling which it is capable of, and it is then collected and again passed into the first cylinder or generator, to be used over again. The process is a very interesting one, the same water and the same ammonia being used repeatedly, and the changes of condition being regulated by the application of heat and cold as described.

The water or brine which is cooled by the expansion of the ammonia can be used for a variety of purposes. In breweries, for instance, the cold water required is passed direct through the coil in the cooler. For ice-making a strong solution of common salt is used instead of water as the circulating medium, as it freezes at a lower temperature, and after this brine has been reduced to a very low temperature by passing through the cooler, it is made to circulate through the ice tanks, and then to return to the cooler to be re-cooled for further use. The ice-boxes are of various forms, but the principle on which their working depends is the same in all of them.

Our illustration shows one made by Messrs. Pontifex and Wood for making pyramids of ice for table



PYRAMID ICE BOX.

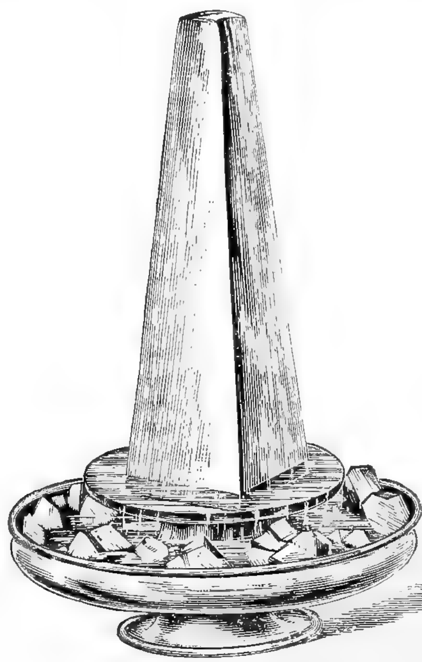
decoration, for cooling rooms, etc. The brine tank is made of wrought iron covered with wood, sawdust being placed between the iron and wood. In this tank there are four ice-moulds made of galvanised wrought iron, pyramidal in form, and in each mould there is a spiral agitator or endless screw, which is used to keep in motion the water in process of freezing. The cold brine enters the tank through a pipe at one end, and leaves the tank at the other end. In this way there is a constant circulation of the brine round the ice-moulds, and as the brine is at a temperature below the freezing point of water, the water in the moulds is soon frozen. The result is a pyramid of clear ice, as illustrated.

ON THE GEOLOGY OF BATH AND THE NEIGHBOURHOOD.

THE rocks which form the crust of the earth are either stratified or unstratified. The former of these have been deposited by the agency of water, and lie one above the other, somewhat resembling the leaves of a book. The strata do not occur indiscriminately, but are arranged in definite order, and are so classed that each formation is characterised by the fossils which occur in it, representing, of course, the life of the period during which the strata was deposited.

The unstratified rocks underlie the stratified, or have been projected into them by forces which are at present imperfectly understood.

The first great system into which the rocks forming the crust of the earth are arranged is that of the Palæozoic. The term is taken from the Greek, *palaios*, ancient, and *zoe*, life, and is applied to the lowest system as holding the most ancient or earliest-known forms of life. Next



ICE PYRAMID, MADE BY THE PYRAMID ICE BOX.
(For table decoration, and for cooling drawing, ball, and assembly rooms.)

comes the Secondary, or Mesozoic system, from *mesos*, middle, and *zoe*, life; and finally the Tertiary, or Cainozoic, from *kainos*, recent, and *zoe*, life. In considering the geology of Bath it will not be necessary to refer to strata later than the Mesozoic.

At the base of the Palæozoic series we get rocks to which the name Laurentian was given by Sir William Logan in 1854, by which term he intended to distinguish a thickness of something like 30,000 feet of strata, typically developed in the Laurentine Hills of Canada. Rocks which are probably the representatives in time of the Laurentians of Canada occur in this country, and are generally spoken of as the Archæan, a term proposed by Professor J. D. Dana, in 1874, to include the Laurentian group and rocks contemporaneous with them. The nearest locality to Bath at which rocks of certain Archæan age are exposed is in the Malvern Hills.

Next in the order of succession come the Cambrian series, in which life is abundant; but as there are no good exposures within easy range of Bath, it is not necessary to do more than mention them.

Much the same may be said of the next great formation, that of the Silurian, a term given by Sir R. Murchison to the rocks which range between the Cambrian and Old Red Sandstone. He considered them to be typically developed on the eastern borders of Wales, in a region once occupied by the Silures, and hence the name Silurian. They are to be seen in the neighbourhood of Tortworth, in Gloucestershire; but the exposures are not good, and would hardly repay a visit unless to a specialist who had some particular object in seeing them. May Hill, on the borders of Herefordshire and Gloucestershire, is a well-known locality for what Murchison, in 1834, termed the "May Hill Series," which include—

(3.) Tarannon shales.
(2.) Upper Llandovery rocks.
(1.) Lower Llandovery rocks.

The Silurian period was brought to a close by conditions which allowed of the deposition of a series of sandstones and shales known as the Dawnton Sandstone, but which are really passage-beds from the Silurian to the Old Red Sandstone. At Ledbury, between Gloucester and Malvern, these interesting beds have been cut through by the railway to Malvern, and the section thus exposed is one of the finest known. Mr. Piper, F.G.S., a local resident, has made a special study of this strata, and has obtained a good collection of the fossils which occur; among them are Cephalaspidean fish belonging to the genus *Auchenaspis Egertoni* and *A. Salteri*. Though Ledbury is located at the extreme north-western limits of Gloucestershire, it is easily accessible from Bath. Quick trains on the Midland Railway run to Gloucester, where it is necessary to change on to the new line to Malvern. On arriving at Ledbury the passage-beds are seen close to the station. For geologists who have not had an opportunity of previously examining the strata a journey is well worth undertaking from Bath.

In the Mendip area of Somersetshire, and in Gloucestershire and Herefordshire, the Devonian period, which follows the Silurian, is represented by the Old Red Sandstone and Conglomerate, but in Devonshire and West Somerset the strata of this age is all termed Devonian. One locality, where the Old Red can be studied, is below the gorge of the Avon at Clifton, a suburb of Bristol. There a continuous succession of Old Red and the rocks of the succeeding carboniferous period may be studied without a break. It is most probable that an excursion will be made to this picturesque and interesting spot during the meeting of the British Association at Bath, and therefore it will be well to refer to it in some detail.

Commencing, then, with the Old Red Sandstone, we find it represented by two types of rock—namely, (1) red and mottled sandstones, and (2) by a conglomerate. The former of these are more or less continuous from Portishead to "Cook's Folly," below Durdham Downs. The life of the period was remarkable for the fish which lived in the waters; and so characteristic are they of Devonian days that the period has appropriately been popularly termed the "Age of Fishes." They mostly belonged to the *Ganoid* and *Placoid* groups, more especially to the former. The *Ganoids* were fish having angular scales regularly arranged, composed of horny or bony plates, and covered with a strong, shining enamel. This group of fishes is now nearly extinct, the best known remaining representatives being the *Lepidosteus* (bony pike) of America, the *Polypterus* of the rivers of Africa and the Nile, and the sturgeons. At Portishead a fish-bed exists which has yielded *Holoptychius* and *Coccosteus*. At the foot of "Cook's Folly" the uppermost beds of the Old Red period are represented. They are those of the conglomerate, which is made up of opaque quartz pebbles, called by Sir H. de la Beche "veinstone quartz," and grains of sand, the whole being cemented together by a siliceous ferruginous matrix. Following the Conglomerates in the order of succession, we find the pebbles become less numerous, and finally almost disappear. The strata then becomes of a loose, sandy nature with some shales, which indicate that the conditions under which the Conglomerate was formed were gradually coming to an end, and that another period of the history of our planet was about to begin. That period was the Carboniferous, during which great thicknesses of limestone were first formed. Then an alteration took place, and vast quantities of sediment were spread over the sea floor, in much the same way that sandy *débris* is brought down into the open sea by the river Plate in South America. Apparently the limestone was deposited in the open sea, and was brought to an end by the rising of the sea floor, which allowed of the formation of the Millstone Grit from the *débris* derived from the denudation of the land. But during that time the sea-floor continued to rise, and after over 900 feet of sediment (Millstone Grit) had been accumulated, the land surfaces appeared on which vegetation grew, the carbonised remains of which we call coal.

But we must study the Carboniferous rocks more in detail. In Gloucestershire and Somersetshire they may be divided as follows :—

	Greatest Thicknesses.
Coal Measures	6,700 feet.*
Millstone Grit	900 „
Upper Limestone	100 „
Middle Limestone	1,600 „
Lower Limestone Shales..	990 „

Above the sandy beds which mark the close of the Old Red Conglomerate, we find a mixture of dark limestones and shales, hence the name Lower Limestone Shales. To understand the history of these limestones they require to be reduced to thin sections, and be

* This represents the thickness of the Coal-measures in Bristol. In the Somersetshire Coalfield the thickness is a little over 7,500 feet.

examined under a microscope. Examined as a hand specimen, many, perhaps the greater part, show no structure and we are tempted to throw specimens away as "only a piece of limestone." But make a thin section, which is not a difficult matter, and the rock will tell a different tale. Some beds are made up of little else than the valves of *Ostracoda*, a tribe of small Crustacea, which are allied to what are commonly known as water-fleas. The bodies of these little creatures were protected by bivalve shells, containing car-

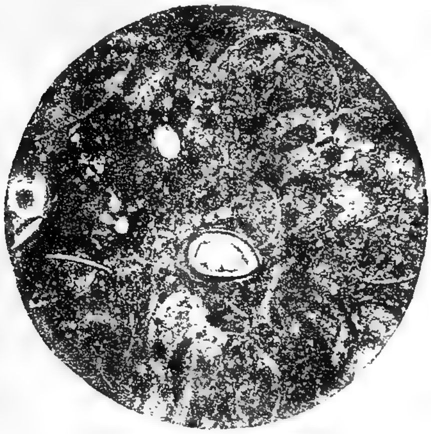


FIG. 1.

Section of a piece of Limestone from the Lower Limestone Shales. ×40 diams. Shows it to be made up of the valves of *Ostracoda.*

bonate of lime, and on the death of the organism the shells collected on the sea floor in such vast numbers that whole beds of limestone are made up of them. A micro-photograph from a piece of this limestone, from the Lower Limestones of Clifton, is represented in Fig. 1, and it is seen to be full of the valves of *Ostracoda*, appearing, of course, in section.

Associated with the *Ostracoda*, in the Lower Limestones,

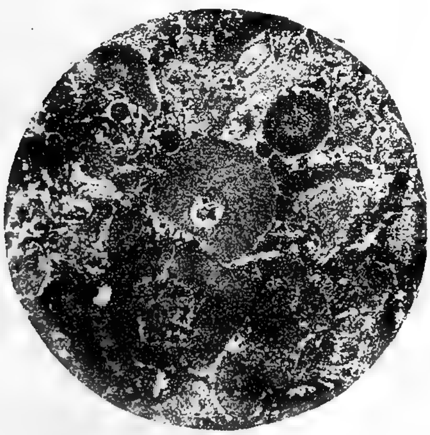


FIG. 3.

Section of the Middle Limestone at Clifton. × 40 diam. Shows it to be made up of Forminifera and the very minute Calcisphæra, represented by the circular bodies.

are the remains of Encrinites, better known as Sea Lilies, of which illustrations can be seen in most textbooks of geology.

They consisted of a stalk or stem, constructed of circular joints, which, fitting one into another with most beautiful adjustment, give the requisite flexibility and strength to enable the Encrinite to bend about in all directions. This stem supported a cup-like body or calyx, as it is termed, which was constructed of calcareous plates. From the margins of the calyx five to seven jointed arms radiated, and from these other jointed projections, called by Miller tentaculated fingers. With these the creature seized its prey, which it conveyed to the mouth, located in the centre of the calyx. Encrinites must have been most abun-

FIG. 2.

Section of the Black Rock Limestone of Clifton. ×20 diam. Shows it to be made up of the joints of Encrinites.

dant during carboniferous days, and the joints and plates composing their structure collected on the sea floor in such vast numbers that extensive masses of limestone are made up of them. A notable instance of this is the "Black Rock," the upper division of the Lower Limestones at Clifton, which is about 490 feet thick (fig. 2.)

To see the Encrinital remains in the Black Rock does not necessarily require a microscope, and no diffi-

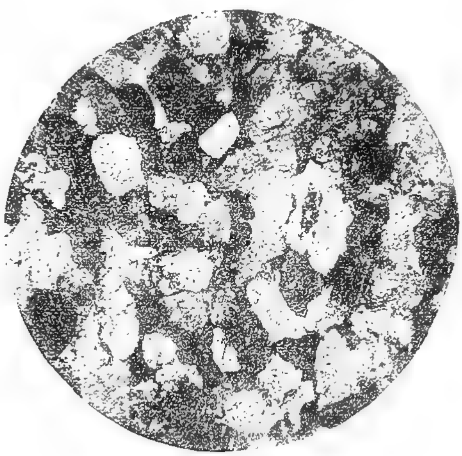


FIG. 4.

Section of Pennant Sandstone. ×20 diam. Shows it to be made up chiefly of grains of sand.

culty will be experienced in finding confirmation in hand specimens, especially if polished. This limestone is also remarkable for the fish remains which it has yielded, some of which were figured by the celebrated naturalist, Agassiz. Proceeding further up the Gorge, we pass over other limestones, one of which shows oolitic structure, and is exposed on the Gloucestershire side of the Avon, at the entrance to the Gully. We then pass to the Middle Limestone, which extends as a bold line of cliffs up to the hot wells. In this limestone corals, shells, and polyzoa will be found in some beds, but for the most part the rock appears structureless to the naked eye, but a thin section will show it to be full of the remains of microscopic organisms. These largely consist of Foraminifera and a minute organism, averaging about ·005 of an inch in diameter, named by Professor Williamson, of Manchester, *Calcisphœra.* The Foraminifera consists of minute, sometimes many-chambered shells,* filled with a jelly-like, structureless sarcode, in which the most powerful microscopes have failed to detect structure. They occur at the present time in vast multitudes in the calcareous ooze now forming in parts of the Atlantic, and in other seas of lesser depth. As to the exact nature of the *Calcisphœrœ* that at present is a little uncertain. The appearance is that of a minute hollow sphere of carbonate of lime from which spine-like filaments project. In fig. 3 these organisms appear like rings, which arises from the hollow spheres being cut in section.

The Carboniferous Limestone is extensively represented in the Mendip Hills, which extend as a lofty ridge across the northern part of that country. The scenery in the hills is very beautiful, traversed as they are by valley and gorge. The most striking of the latter is the well-known Gorge of Cheddar, situated about twenty-seven miles south-west of Bath, and easily reached by train. There the limestone cliffs rise 420 ft. above the road, crowned by rugged peaks and other grand illustrations of natural rock sculpture.

The hills are traversed by underground water courses and caves. The stalactite caves of Cheddar have long been famous, and within the last two years others have been discovered by a Mr. Gough. One of these, the "Fissure Cave," is especially instructive, as demonstrating how caves are developed out of fissures.

The Mendip Hills are also traversed by veins of lead ore, and in past times have been extensively worked. Mr. M'Murtrie, of Radstock, tells us that old records in the hands of the Waldergrave family state that at the time of Edward IV. the lead-mines of the Mendip Hills employed 10,000 miners.

Passing now to the Coal-measures, we find that within a few miles of Bath there are two coal-fields, namely, the Bristol and Somersetshire. They are regarded as having been once connected with the South Wales Coal-field, and that the separation took place at the close of the Palæozoic Period, when the strata was folded into anticlinal and cynclinal curves. The anticlinals were raised above the sea-level, and were removed by long-continued denudation, while the cynclinals assumed a basin shape, and were subsequently raised above the sea.

The Coal-measures of the Bristol Coal-field consist of three series, thus—

3. Upper Coal-measures	.. about	3,000 feet
2. Pennant Sandstone	.. "	1,700 "
3. Lower Coal-measures	.. "	2,000 "
	"	6,700 "

The lower series are worked at Ashton, Bedminster, Easton, Kingswood, and Yate. There are twenty-three seams of coal, which are separated one from another by sandstones, shales, and clays. The middle or Pennant Sandstone series are the least important, and are remarkable for the great development of blue and grey sandstone, known as the "Pennant," which is extensively worked for building and other purposes. Quarries are opened in this rock at Crew's Hole, Fishponds, Downend, and near Warmley, between Bath and Bristol. Plant remains are fairly numerous in this sandstone, and have the advantage of being more durable than those obtained from over seams of coal. They are chiefly Lepidodendra, Sigillaria, and Calamites.

* Scientific News, vol. i., 388, 413, 451.

There are fifteen seams of coal in the Pennant series, and numerous carbonaceous shales which cannot be called coal, as we understand the term. They yield a red and purple ash, and some contain what for coal is a high percentage of sulphur. They are worked chiefly for house purposes, and only to a limited extent. At Mangotsfield station, between Bath and Bristol, on the Midland Railway, there is a very fine exposure of the Pennant Sandstone with two seams of coal. An examination of this section is especially instructive as demonstrating the conditions under which the seams were formed. Each seam rests on a bed of clay, called the under-clay, and over the top of the coal is a slate, and then come beds of sandstone. Many years ago Sir William Logan pointed out that in the under-clays of South Wales there was to be found a fossil plant named *Stigmaria.* This fossil was subsequently discovered to be the root of the fossil tree Sigillaria, and still later of other varieties and allied genera included under the term Lepidodendroid plants. From this fact the inference was drawn that the under-clays were the soils upon which the coal-forming plants grew, and that the vegetation was chiefly some form of Lepidodendra or Sigillaria. The exposure of the Pennant Sandstone at Mangotsfield shows that the soil was subject to constant submergence, and on these occasions the vegetation became covered up by sandy *débris,* which in time became beds of sandstone. Fig. 4 is a micro-photograph of a piece of Pennant Sandstone, showing it to be made up chiefly of grains of sand which have been cemented together by a siliceous matrix deposited between the grains by percolating water.

The Somersetshire coal-field may be divided in much the same way as that of Bristol, but there are some seams in the Upper Coal-measures which do not occur in the Bristol area. Mr. J. M'Murtrie,* a well-known authority on the coal-field, gives the following divisions:—

Upper Divisions.	Radstock Series. Farrington Series.
Pennant Rock.	
Lower Division.	New Rock Series. Vobster Series.

From the above it will be seen that the upper series consist of two sub-series, the Radstock, and Farrington, making a total thickness of about 2,000 feet. Then follows the Pennant Sandstone, with a thickness of from 2,500 to 3,000 feet, and lastly the lower division including the New Rock and Vobster Series; the total thickness of the two representing something like 2,800 feet of strata.

(*To be continued.*)

* Paper read before the Somersetshire Archæological and Natural History Society, at Frome, 11th August, 1875.

General Notes.

Composition of Tussur Silk.—According to Messrs. Bastow and Appleyard, the fibroine of tussur silk differs decidedly in its composition from that of ordinary silk. It contains less carbon, considerably less nitrogen, and more oxygen than the fibroine of mulberry silk. It is less readily acted upon by acids, alkalies, and by chloride of zinc.

The Ruby Mines of Burma.—At depths varying from ten to thirty feet there occurs, in the flatter lands of the valleys, a stratum of corundum varying from a few inches to a few feet in thickness, and abounding in small rubies, most of which, however, are irregular in shape. So rare is a ruby of the first water that one of three carats is worth ten times as much as a diamond of the same size.

Liverpool Astronomical Society.—The Journal of the Liverpool Astronomical Society appears this month under the new editorship of Mr. Isaac H. Isaacs, who promises a "Popular History of Astronomy" from his pen, intended specially for those beginning astronomical work. This publication is a very creditable one, and contains, in addition to the more formal "Proceedings," a variety of information of a useful type.

Paraguay Tea (Mate).—Attempts are being made to introduce maté into European consumption. It is said (*Humboldt*) to contain 1·5 to 1·7 per cent. of caffeine. Its physiological action is essentially like that of tea, though it is less exciting, and does not occasion sleeplessness. It is also free from tannin, and can, therefore, be safely consumed along with gelatinous and albuminous matters. The total yearly consumption exceeds 60 million lbs., 28 million lbs. of which are produced in Brazil and the rest in Paraguay.

Action of very Cold Baths.—According to M. Ch. F. Quinquand (*Comptes Rendus de la Sociéte de la Biologie*), very cold baths occasion a notable increase of the absorption of oxygen, of the carbonic acid expired, of the total volume of air respired, and of the oxidation of the tissues. Very hot baths act in a similar manner, but to a less extent. Both very hot and very cold baths may prove rapidly fatal. A dog cooled down to a rectal temperature of 73° to 75° Fahr. can be saved by plunging it into a bath at 122°, when it recovers in a few minutes.

Archæological Association. — The British Archæological Association, of which the Marquis of Bute is this year the president, began its sittings in Glasgow on Monday. Sir James King, Lord Provost, welcomed the members to the city, and Sheriff Berry and Mr. John Honeyman, Chairman of the Reception Committee and President of the Glasgow Archæological Society, gave them greeting. The members afterwards visited the ancient Celtic camp at Langside, near Glasgow, and were present when a memorial, recently erected on the site of the battle of Langside, was handed over to the patrons of Hutchison's Hospital. They afterwards visited the cathedral.

The Grotto of Reilhac.—According to a correspondent of *Cosmos*, an interesting grotto has been found at Reilhac, in the canton of Livernon and department of Lot. The owner of the grotto, on digging, found several layers of earth, each of rather more than half a yard of thickness, and separated from each other by a kind of concrete. In these layers there have been found a number of flint implements (hatchets and knives), arrows of bone, and some truncheons of bone (for each of which the sum of 100 francs has been offered him), many antlers of deer, among which is one of extraordinary magnitude, which may have belonged to a reindeer. He found also a bone of unusual magnitude, which he parted with for 50 francs, some curious fragments of pre-historic pottery, jaw-bones and teeth of an incredible size. He is selling these bones to rag-men at 1 sou per kilo!

Contribution to our Knowledge of the Connection between Molecular Structure and Physiological Action.—W. Filehne (quoted in *Humboldt*) finds that it is possible from atropine, which has feeble locally anæsthetic properties, to split off tropaic acid and tropine. In like manner, from homatropine, which has a decidedly more paralysing action upon the ends of the nerves of sensation, there may be split off amygdalic acid and tropine, and from cocaine, benzoic-ecgonine. Amygdalic acid stands chemically in the middle between benzoic acid and tropaic acid. The conjugation of ecgonine with benzoic acid seems to be the essential point in the decisive anæsthetic property of cocaine, since ecgonine itself is inactive in this respect. We have thus a series of increasing activity passing from tropaic acid through amygdalic acid to benzoic acid. The author, therefore, conjectures that the substitution of benzoic acid for tropaic acid or amygdalic acid would produce anæsthetics more powerful than atropine and homatropine. The benzol tropine thus obtained verified his conjecture. A series of other alkaloids were combined with benzoic acid, and all these benzoyl-derivatives proved to have an action like cocaine.

Lightning Accidents.—In the *British Medical Journal* there is an account by Drs. Cook and Boulting of the injuries received by two sawyers on the Spaniards Farm at Hampstead. The man most injured, the elder of the two, was leaning against an oak tree. There was no rain nor any sign of a thunderstorm. The other was sitting on a block of wood 3 ft. away, and two saws, 6½ ft. long, were leaning against the fence about 2 ft. from the trunk of the tree. The first man saw nothing and felt nothing; he was struck senseless instantaneously. The second heard a deafening thunder clap and felt stunned for some minutes, but had no sensation of pain. Then he discovered that his clothes were smoking and burning, although not ablaze. He then saw his companion lying senseless on the ground, quite still, as if dead, and his clothes partially torn from him. Having put out the fire in his clothes, he crawled (he could not walk) to the road near and shouted for assistance, which soon arrived, and both men were conveyed to the infirmary, where, upon being roused, the elder man regained consciousness to a slight extent. Burns were found on the right side from the shoulder to the feet. The legs of the other man also had marks as of burns; both were in a state of collapse. After eleven days in the one case and fourteen in the other the men recovered.

The doctors remark that it should not be forgotten that dangerous return discharges from the earth to the atmosphere may take place at a considerable distance from an atmospheric storm.

THE LATE MR. W. H. BAILY.—The death is announced of Mr. William H. Baily, acting palæontologist of the Geological Survey of Ireland. Born at Bristol in 1819, deceased secured an appointment in the Bristol Museum at the age of 19. This he held until 1844, when he was attached by the late Sir Henry de la Beche to the Geological Survey of England, first as a draughtsman, and afterwards as assistant naturalist under Edward Forbes and subsequently under Professor Huxley. In 1857 Mr. Baily was transferred to the Irish branch of the Geological Survey as palæontologist, and this post he held until his death. He was also demonstrator in palæontology to the Royal College of Science, Dublin. Mr. Baily was a frequent contributor to the Proceedings of the Royal Irish Academy, of the Linnean and Geological Societies of London, and the Royal Geological Society of Dublin, as well as of various kindred societies in Europe and the United States. He was also an assiduous attendant at the meetings of the British Association. Mr. Baily's most important work was his "Characteristic British Fossils," which was produced at great expense, and was incomplete at the time of his death. He was also the author of a work published last year, entitled "Rambles on the Irish Coast; especially relating to its Geology, Natural History, and Antiquities."

OBSERVATIONS ON THE PERCEPTION OF COLOURS.—H. W. Vogel communicates some interesting results to the *Naturwissenschaftliche Rundschau* and *Humboldt*. It is already known that a table of colours if illuminated with the monochromatic yellow sodium light makes no coloured impression. The several colours appear merely as gradations of black and white. The yellow squares appear white, partly a purer white than the white paper upon which they are fixed. It is further known that the several colours at once appear as soon as a bright candle is placed alongside the sodium flame. But this experiment has hitherto not succeeded with any other light. Vogel has at last succeeded in producing other monochromatic lights by using green lamp-cylinders of chrome-glass and dark-red cylinders of copper glass. If such cylinders are used with powerful petroleum lamps, and if all white light be excluded, a result is obtained analogous to that with the sodium-light. With the red light all red colours appear pure white, and all others grey or black. With the green light there is a corresponding phenomenon. With blue cobalt-glass the experiment succeeded only if a solution of copper oxide in ammonia was interposed in the course of the light, as cobalt-glass transmits a part of the red ray along with the blue ray.

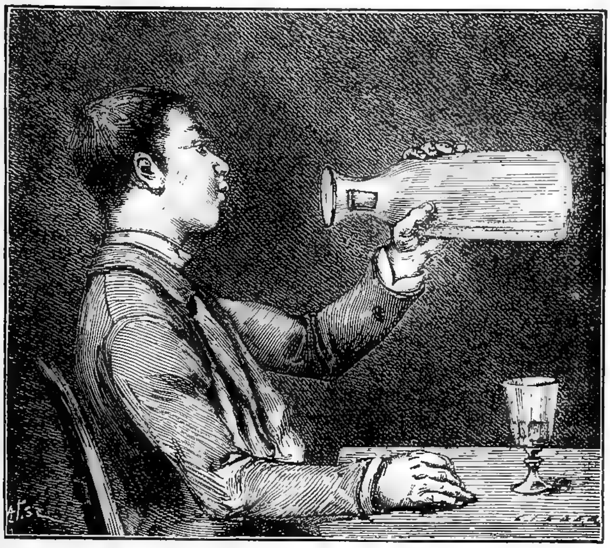
THE PUBLIC HEALTH.—The Registrar-General's return for the week ending August 18th shows that the deaths registered during that period in the 28 great towns of England and Wales corresponded to an annual rate of 16·4 per thousand of their aggregate population, which is estimated at 9,398,273 persons in the middle of this year. The six healthiest places were Nottingham, Bolton, Birkenhead, Birmingham, Bristol, and Sunderland. In London 2,604 births and 1,330 deaths were registered. Allowance made for increase of population, the births were 187 and the deaths 310 below the average numbers in the corresponding weeks of the last ten years. The annual death-rate per 1,000 from all causes, which had been 15·9, 15·9, and 18·0 in the three preceding weeks, declined again last week to 16·2. During the first seven weeks of the current quarter the death-rate averaged 16·0 per 1,000, and was 5·2 below the mean rate in the corresponding periods of the ten years 1878-87. The 1,330 deaths included 33 from measles, 17 from scarlet-fever, 13 from diphtheria, 20 from whooping cough, two from typhus, two from enteric fever, one from an ill-defined form of continued fever, 162 from diarrhœa and dysentery, four from cholera and choleraic diarrhœa, and not one from smallpox; thus 254 deaths were referred to these diseases, being 138 below the corrected average weekly number. In Greater London 3,372 births and 1,649 deaths were registered, corresponding to annual rates of 31·8 and 15·6 per 1,000 of the population. In the Outer Ring 31 deaths from diarrhœa, eight from whooping cough, seven from measles, and five from diphtheria were registered. The fatal cases of diarrhœa included nine in West Ham district and nine in Tottenham sub-district; four deaths from measles occurred in Tottenham, and two of diphtheria in Croydon sub-districts.

THE LATE MR. P. H. GOSSE.—The death is announced of the distinguished zoologist, Mr. Philip Henry Gosse, F.R.S., at his residence, St. Marychurch, Torquay, on the 23rd inst. He was born in Worcester in 1810, and in his childhood he displayed a strong taste for natural history. In 1827 he went out in a mercantile capacity to Newfoundland, where he occupied his leisure in collecting insects. In 1833 Mr. Gosse visited Lower Canada, where for three years he specially devoted himself to the study of zoology and entomology. He afterwards travelled through the United States, and resided for about a year in Alabama. In 1839, after his return to England, Mr. Gosse published a general synopsis of his investigations, under the title of "The Canadian Naturalist." A visit to Jamaica in 1844 resulted in "The Birds of Jamaica," followed by an "Atlas of Illustrations," and "Naturalist's Sojourn in Jamaica." During the next few years he published an "Introduction to Zoology," and prepared many works for the Society for Promoting Christian Knowledge. He took a prominent part in the formation of public and private collections of marine animals, and was elected a Fellow of the Royal Society in 1856. Among Mr. Gosse's works are "The Aquarium," 1854; "A Manual of Marine Zoology," 1855; "Tenby, a Seaside Holiday," 1856; "Life in its Lower, Intermediate, and Higher Forms," 1857; "Actinologia Britannica; a History of the British Sea Anemones and Corals," 1860; "The Romance of Natural History," 1860-62; "A Year at the Shore" and "Land and Sea," 1865. He likewise pursued a series of microscopical investigations into the character of the family papilionidæ, and the first fruit of those studies appeared in the Transactions of the Linnean Society. Up to the year 1863 the Royal Society's catalogue of scientific papers contained no fewer than 51 articles attributed to Mr. Gosse's pen; and these were subsequently added to. In 1874 he published at Philadelphia his "Wonders of the Great Deep: or, the Physical, Animal, Geological, and Vegetable Curiosities of the Ocean."

EXPERIMENTAL PHYSICS.

HERE is a carafe with a wide neck, which we hold horizontally, having placed a cork loosely inside its neck. "Will you," we said to a young student of physics, "attempt to blow upon the cork? We defy you to drive it into the carafe." Our friend took the carafe in one hand, as shown in the figure (from *La Nature*), and with the calmness of a man sure of success, puffed out his cheeks, filled his mouth with air, and blew strongly upon the cork, believing that he could drive it to the bottom of the bottle. The instant he blew, the cork, as if projected by a spring inside, issued violently from the mouth of the bottle and struck the experimentalist on the lips.

The explanation of the phenomenon is easy: on blowing into the confined space within the bottle, the internal air is compressed, and then, expanding again, throws out



Bottle Experiment.

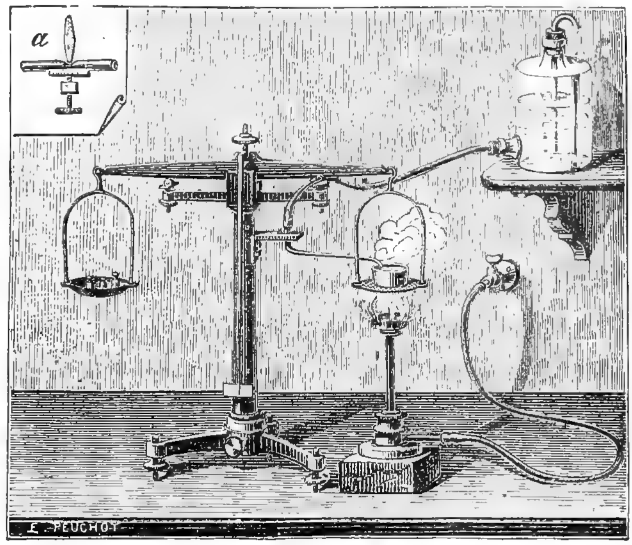
the cork, the projection of which will be more energetic the more strongly the experimentalist has blown.

Some precautions are necessary for success: the carafe must be perfectly dry, especially in the neck, as moisture might cause the cork to adhere, and it must also be very smooth.

AUTOMATIC CONSTANT-LEVEL BALANCE.

THE analysis of potable or of mineral waters generally requires the evaporation of 2, 5, 10, or perhaps even 20 litres of water, and when it is required to ascertain the residue per litre, or to determine the silica, we must operate in a platinum dish, the use of porcelain or glass not being possible. This operation must also be conducted with care, because brisk ebullition might occasion a slight loss, especially in case of a magnesian water. All spirting must also be avoided. The appliances devised for this purpose not working satisfactorily, M. Charles Truchot proposes, in *La Nature*, the apparatus of which we copy the figure and description. It consists essentially of an ordinary balance supported on a pillar and corresponding in size with the capsule to be used. One of the pans is substituted by a piece of wire gauze upon which is set the capsule. In the other pan are put weights so as exactly to counterpoise the capsule. By means of a slight modification in the fork, which checks the oscillations of the beam, a narrow caoutchouc tube may be compressed between the beam and this fork.

The tube communicates, on one hand, with a Mariotte's bottle containing the water to be evaporated and the bent end of which ends above the capsule. Things being thus arranged the water will flow into the capsule as soon as its weight is insufficient to overbalance the counterpoise. This counterpoise is so arranged that when the capsule is three-fourths full it slightly preponderates. The beam then lowers, pinches the caoutchouc tube, and the flow of water stops. If there is a gas burner placed below the capsule, as in the figure, the evaporation soon begins, the capsule becomes lighter,



Automatic Balance.

the beam rises, ceasing to press upon the flexible tube, and the water flows again.

Experience shows that the apparatus is self-acting, so that the water falls drop by drop at the rate of 30—60 drops per minute according to the rapidity of the evaporation, so that the level is kept constant. The level depends simply on the tare and the number of drops must depend on the intensity of the evaporation, consequently on the temperature applied.

If it be feared that the supply may cease when the bottle is empty and the deposit may be calcined the other end of the fork may be made to pinch the tube which supplies gas to the burner. If the capsule is not supplied the gas flame lowers and is extinguished before the deposit becomes dry.

ODOURS, AND THEIR FUNCTIONS.

THAT almost all plants and animals throw off volatile matters which affect our sense of smell is a fact perfectly admitted. That the more susceptible olfactory organs of certain lower forms of life will be more vividly impressed than our own will also not be disputed. But when we come to ask why this or that organic species gives out some peculiar scent, we are still very much at a loss. Much good work has, indeed, been done of late years in explaining the use of the odours of certain flowers in attracting insects whose visits are essential to their fecundation. The results of such investigations will, of course, be familiar to most of our readers. But there are in this connection a multitude of unsolved questions, and to these we wish to direct the attention of young naturalists as a fruitful field for study and observation.

In the first place, there are flowers not a few of which give off scents ranging from the slightly disagreeable to the positively loathsome. There are the sickly smell of the common elder blossom or the sunflower, the peculiar bitter—we use this term for want of one more definite—of most of the Compositæ, such as the dahlia, the common marigold, the African marigold, and in a more intense degree Coreopsis Drummondi; the indescribably fetid exhalation of certain Aroids, and of a giant Bulbophyllum referred to in our recent article on orchids. What function do these smells subserve? Are they, like perfumes, to attract some insect which may convey the pollen of one flower to the pistil of another, and thus promote fecundation? If so, what insect? Certainly no bee or butterfly. The likings of these insects as regards odours are admittedly not like our own. We see both butterflies and bees preferring the sugary but sickly aroma of the privet, the African sedum, the sweet marjoram, and the prickly comfrey to the delicious fragrance of the syringa, the orange-blossom, or the lavender. But for all this none of them, as far as we have observed, like positive stenches.

In some cases flowers seem to find their advantage in smelling like carrion. Blow-flies are seduced, as may be found mentioned in the text-books, into depositing their eggs in such flowers. The young grubs perish as a matter of course, and the flower, in some manner which requires further investigation, preys upon their remains. But many evil-smelling flowers do not in the least remind us of putrid animal matter, and in fact have not been seen to be visited by blow-flies.

Have the offensive smells been developed in order to repel some enemy? If so, they often fail. Every gardener knows, for instance, that the destructive earwig is found as abundantly in the disagreeably-smelling dahlia, sunflower, or marigold as in the fragrant carnation or white lily.

Then we have to consider the smells, good or bad, proceeding not from the flowers of any plant, but from the fruits, the leaves, the stem, or the roots. Here the fecundation of the seed and the prevention of self-fertilization do not come into any direct play. Not a few plants have altogether very agreeable odours. Of these, the sweet briar is the most familiar instance. What advantage, if any, does it gain in comparison with other members of the great rose family by the fragrance which pervades its leaves and its shoots? So far "the oracles are dumb." On the opposite side we have plants which give out a more or less disagreeable smell, especially when crushed, such as the so-called dead nettle. But the function of this and similar unpleasant scents, *e.g.*, that of the leaves of the common scarlet geranium, is still a matter of doubt. The odours of a number of plants, such as thyme, mint, and lavender, have been explained as protective, not against insects but against cold. The scents of such plants, indeed of the Labiates generally, are due to essential oils, which being very volatile, constantly envelope the plants in an atmosphere which hinders them from losing heat by radiation in a chilly night as readily as it would otherwise be the case. This explanation is the more probable, as the Labiates for the most part are intolerant of frost.

Another explanation of the smells of parts of plants other than the flowers, is that they are intended to attract, or respectively to repel, animals which might eat such parts. We may easily conceive that it might suit the—of course unconscious—purposes of a plant that its fruits should be eaten by some kinds of animals and not by others. If consequently it develops a scent which attracts the former and repels the latter, it may find a benefit. Now, a scent good or bad will have this effect, and as all animals do not approve of the same kinds of scents, the effect will possibly be selective. If the question be raised why it should make any difference to the plant by what animal its fruits are consumed, the answer is not far to seek. One species may swallow the seeds unbruised, and may afterwards excrete them uninjured. In this manner their dispersion will be promoted, and each will be accompanied by matter which will promote its germination and growth. Another fruit-eating species, *e.g.*, rodent mammals, may gnaw the seed to fragments, especially if large, or may swallow it whole or in pieces and digest it, as do many birds. It is plain that to be eaten in this manner is a hindrance to the perpetuation of any vegetable species.

It must be remembered that the smell of a fruit or other part of a plant does not by any means invariably give a clue to its taste. Thus the smell may be more or less repellent, but if this warning be neglected the taste may prove pleasant. The most striking instance of this is the durrian, of the Malay Islands.

Every stranger, on his first contact with this fruit, loathes its smell, and we believe every one who makes the experiment finds its taste delightful.

A less striking, though unquestionable case, is that of the onion family, universally denounced for their smell, but almost as universally eaten. Farmers are often annoyed at the avidity with which their cows will browse the wild onion, if accessible, thus injuring the flavour of the milk and butter. The smell of the onion is thus no protection.

On the other hand, a pleasant odour may accompany a very unpleasant taste. In decoctions of certain very bitter roots, such as gentian and calumba, a fruity odour may usually be perceived. What can be the purpose of the smell?

Very many kinds of trees and shrubs when first coming into leaf, and before the flowers appear, have a decidedly pleasant odour. Prominent in this respect are the Canada poplar, the pines when putting out fresh growths, the birch and the oak. Here, again, we do not know what purpose is thus served.

It is not easy to imagine how a plant of any kind can be benefited by having its leaves or sprouts eaten away, whether by cattle, rabbits, locusts, cockchafers, or slugs. Yet odours which effectually repel such attacks are very rare.

To conclude with an irrelevant and, we fear, unanswerable question, we must ask whether the snails and slugs were originally consumers of dead and decaying vegetable matter, and have since extended their ravages to healthy leaves, fruits, and flowers, or whether they were originally devourers of fresh plants, and have subsequently taken to eating vegetable refuse?

Natural History.

THE SING-SING ANTELOPE.

TRUE Africa—the Ethiopian region of Sclater and Wallace—is remarkable for its number of antelopes, which seem here to replace the deer of Asia, Europe, and America, never found to the south of the Great Desert. From deer, which they much resemble in form, in diet, and in general habits, the antelopes are most easily distinguished by their horns. The horns, or antlers, of deer are shed and renewed annually, and consist of solid bony matter throughout. The horns of the antelopes, like those of oxen, are permanent structures, each consisting of a so-called "core," a bony process of the skull which supports a sheath of horny matter. This matter is in its chemical composition very distinct from bone, and differs little from that of hair, nails, skin, etc.

The animals of Africa proper—that is, the part lying to the south of the Sahara—vary exceedingly little throughout a vast range of country. Hence there has arisen confusion. A traveller observing some unrecorded animal, say in the south of Abyssinia, gave it a distinct name, though in reality it might be merely a local variation of some species which has already been described from some distant side of the continent.

THE SING-SING ANTELOPE (*Kobus sing-sing*).

Such is the case with the "sing-sing" antelope (*Kobus sing-sing*), a figure of which we here borrow from *La Nature*.

The Jardin des Plantes has quite a herd of these fine animals, the issue of a male and two females brought in 1880 from the Senegal by M. Brière de l'Iske, who had been governor of that colony.

These "kobs," as they are called in Senegambia, are of a robust but elegant form. Their pointed horns diverge like the arms of an ancient lyre, and are then again slightly curved inwards at the extremities. They are marked with rings for two-thirds of their length.

The neck of the animal is clad with a sort of mane. The rest of the body is covered with hair, shorter than the mane, but longer than that found in many kinds of antelopes, and constantly saturated with a fatty matter. This peculiarity was observed by Laurillard, who proposed to give this species the name *Antilope unctuosa*.

The general colour is a light-reddish maroon, passing into a yellowish white on the posterior region and the inner side of the limbs, and into a greyish white on the throat and the cheeks. The lower parts of the limbs are of a dark brown. The tail, relatively thin, ends in a tuft of black hair. The ears, edged with black on the outside, are garnished within with long white hairs, and there are white lines or patches near the hoofs, above the eyes, on the upper lip, and the chin.

The kobs of Senegambia are found commonly in the Cayor and Upper Senegal, and, according to Gray, on the banks of the Gambia, a region decidedly tropical. Yet these animals, if transported into Europe, do not appear to suffer from the severity of our winters. At the Jardin des Plantes they spend much of their life in the open air, and have no shelter except a shed not heated. Yet they preserve their health and multiply as well as in their native country. No fewer than ten of these antelopes have been born in the gardens. It is thought that this species might exist at large in France. In England its naturalization, if practicable, would not be desirable, as every game bird or beast introduced serves merely as a focus for the contending powers of gamekeepers and poachers, each body suspecting the botanist, the entomologist, the geologist, or the artist of being an ally of its enemy.

It seems probable that the antelope discovered in Abyssinia by Ruppell, and named by him *Antilope defassa*, is identical with the kobs or sing-sing of Senegambia. Mr. J. Murie (Proceedings of the Zoological Society of London) states that some skins of the antelopes in question, brought from the region of the Upper Nile, twenty years ago, by Baron von Harnier, and preserved in the Grand Ducal Museum of Darmstadt, possess neither the unctuous feel nor the long tufty hair of *Kobus sing-sing*. The skin is also of a colour less reddish and more brown than that of the Senegambian species. The horns, however, are exactly like those of the sing-sing, and the same characters are found in the head of an antelope brought from Uganda by Captain Speke, and belonging, doubtless, to the species which he calls *Antilope N'samma*. The *Antilope Mehedehet*, killed by Sir S. Baker on the banks of the Asna, approaches closely to the sing-sing.

In South Africa there exists another species of *Kobus*, of a more powerful build, called the "crescent kobus" (*Kobus ellipsiprymnus*), on account of a white band which descends from the sacrum and terminates in a point on each thigh. The skin is of a yellowish grey, passing to a reddish brown on the forehead and to a white on the throat, the muzzle, and above the eyes. These animals feed along the banks of rivers in small herds, consisting of several females, two or three young males, and a single adult male, who watches over the safety of the band. If alarmed they rush into a marsh, and thus escape their most terrible enemy, the lion. The natives of South Africa do not hunt this species, on account of the intense rankness of its flesh.

A Luminous Coleopterous Larva from Brazil.—Herr von Jhering (*Cosmos*, from *Berlin, Entom, Zeitschrift*) states that this larva is distinguished from other luminous insects by its double light, which is fiery red at the head and the posterior extremity, but green at the stigmata. The larva was found accidentally by night on turning over a stone, and was about 2 inches in length. The green light issuing from the stigmata seemed to be continuous and independent of the will of the larva, but the red light at the two extremities was sometimes brighter and sometimes fainter. Unfortunately, the creature escaped before its systematic position could be ascertained. According to Von Jhering it appeared similar to the larva of an *Elater* (wire-worm). Dubois thinks that the red light at the extremities may obtain its colour by transmission through red chitine.

The Food of the Sparrow.—The following facts, observed by S. A. Forbes, of Illinois, and recorded in the *American Naturalist* for 1881 (p. 393), may, perhaps, convey a useful lesson to the advocates of the sparrow. The food found on opening twenty-five sparrows shot in and near Aurora, Illinois, in September, "consisted almost entirely of grain." At a time when 30 per cent. of the food of the (American) robin, 20 per cent of that of the catbird, and 90 per cent. of that of the blue bird consisted of insects, no insects were found in the stomachs of these birds, except traces of grasshoppers, making, perhaps, 6 per cent. of the food.

A Cloud of Bees.—On the 22nd inst. a great number of bees made a descent on the confectionery stalls of Bishop Auckland market, and literally took possession of them. Business was stopped, and the owners of the stalls took to flight. It is presumed that the cold and inclement season had deprived the insects of their ordinary source of sustenance, and that they were driven by famine from the country into the town.

Helix Harpa in Switzerland.—According to *Humboldt*, the Belgian naturalist, Alfred Orasen, has found this species upon the Riffel Alp, near Zermatt, at a height of 6,200 feet. Hitherto it has been seen only in Arctic regions and in the north of the United States. It lives under detached pine bark. This is a fact of much interest, as *Helix harpa* has been found inclosed in amber, and has, therefore, not altered its habits since the amber-age.

Abnormal Habits of Animals.—A correspondent of the *Field*, who signs himself "The Doctor," describes certain nocturnal cave-dwelling birds in Trinidad, which, instead of preying on moths, devour the fruit of palm-trees. In another cave in the same island live a colony of bats which have left off insect hunting and live by catching fish! So little can we judge of the habits of an animal from its structure!

Protection for the Sand Grouse.—Baron Von Lucius, the Prussian Minister of Forests, Domains, and Agriculture, recommends that the sand grouse, until further notice, shall be entirely unmolested in all royal forests and domains.

Remedy for the Coffee Disease.—According to the *Medical Press*, Dr. Burck, of the Government Botanical Garden, near Batavia (probably Buitenzorg?) proposes a very dilute solution of chloride of iron as a remedy for the coffee disease, (*Hemileia vastatrix*.)

THE BOTANY OF BRISTOL.—II.

(*Continued from p.* 182.)

THE "Flora of the Bristol Coal-fields," published by the Bristol Naturalists' Society, with its supplements, contains records of about 1,010 flowering plants and vascular cryptogams, excluding varieties, aliens, and casuals. To that work can be referred all those inquirers who desire to become more closely acquainted with our plants in their respective habitats. Three species found in the district do not grow elsewhere in Britain. They are *Dianthus cæsius*, *Arabis stricta*, and *Allium sphærocephalum*; the two last being peculiar to St. Vincent's Rocks and Durdham Down. The pink is also a limestone plant, but grows only at Cheddar, where it is still abundant. *Arabis stricta*, the Bristol rock-cress, is to be found in fair quantity about the rocks overlooking the Avon, and, more sparingly, on the opposite bank of the river, so that it can be claimed by Somerset as well as by Gloucester; but its whole area is extremely small, and it behoves all true botanists to use extreme care in dealing with it. The Downs, rocks, and quarries on the banks of the Avon below Bristol yield most of the limestone species, including many of our best plants. Besides those already mentioned there are met with on St. Vincent's Rocks *Hutchinsia petræa*, *Arabis hirsuta*, *Cheiranthus Cheiri*, *Hippocrepis comosa*, *Pyrus Aria*, *Sedum Telephium*, *Rubia peregrina*, *Blackstonia perfoliata*, *Rumex pulcher*, *Allium vineale* (*compactum et bulbiferum*), *Geranium sanguineum*, *G. rotundifolium*, and *G. columbinum*. On some of the ledges can be seen *Sedum rupestre* (*minus*), flowering but rarely, and it occurs also on the other side of the river. The ivy clothing some of the precipices is much infested with *Orobanche Hederæ*, while the handsome *Veronica hybrida* is plentiful but mostly out of reach. The Alexanders, Parsley, and Fennel may perhaps remain from ancient cultivation, and be descended from pot-herbs used by the hermit who, tradition says, at one time inhabited the Giant's Cave. Early in the spring the flowers of *Potentilla verna* are seen in profusion, and for a week or two one can readily distinguish the spikes of *Carex humilis*. After flowering, the sedge blends its foliage with the turf, and entirely justifies its specific name. If the season be damp and cool, *Cerastium pumilum* is fine and abundant, but a hot dry spring, like that of 1887, gives a tiny annual small scope for development. *C. semidecandrum* grows about the edges of the paths and under the seats, while a dwarf form of *C. tetrandrum* is frequent in the turf near the Observatory, together with *Trifolium subterraneum* and *T. scabrum*. These likewise grow together on Brandon Hill. *Scilla autumnalis* was lost sight of for many years after the construction of Clifton Suspension Bridge, but happily has now been rediscovered within a short distance. The rocky side of the river below St. Vincent's Rocks belongs to Clifton and Durdham Downs. Here may be discovered *Aquilegia vulgaris*, *Spiræa Filipendula*, and *Trinia vulgaris*. The best grasses are *Gastridium lendigerum*, *Avena pubescens*, *A. pratensis*, *Sieglingia decumbens*, *Koeleria cristata*, *Festuca myurus*, *F. sciuroides*, *Bromus erectus*, *and B. madritensis*. All these grow within a very small area. The Fly and Bee Ophrys have become scarce, but *Spiranthes autumnalis* is scattered freely on the Downs. In furzy spots we find *Ulex Gallii*, *Carex pulicaris*, *C. pilulifera*, and *C. panicea*, which flourishes alike on limestone or in marsh. *Carex digitata* is well concealed under bushes, and wants a good deal of looking for. In Leigh Woods it is larger and more abundant. Further westward beyond the limestone there occur on the river bank many other interesting species, from which we may select for mention *Allium oleraceum*, *Trifolium maritimum*, *Lathyrus Nissolia*, *Bupleurum tenuissimum*, *Aster Tripolium*, and *Alopecurus bulbosus*; while in the marsh districts towards Avonmouth are plenty of *Ranunculus Baudotii*, *Ruppia*, *Zannichellia*, and *Potamogeton pectinatus*. The botanist will be equally charmed among the copses and coombes of Henbury and Westbury, or on the wooded banks of Leigh. Leigh Wood is the great hunting ground for mosses, yielding as many as 200 species. Several very rare musci also, including *Grimmia orbicularis* and *Tortula Hornschuchiana*, are to be found on the Gloucestershire side. Mr. Cedric Bucknall has catalogued a very large number of Bristol fungi, some new to Britain, and a few new to science. The latter include *Agaricus Bucknalli*, and will be found described and figured in the transactions of the Bristol Naturalists' Society.

To the deficiency of arable land may be attributed the absence of some agrarian weeds common in other localities. And here comes in the consolatory thought that the cultivation of the soil is not likely to be so much extended in the future as to alter the features of the flora to such a great degree as has occurred in the more highly cultivated and exclusively arable portion of the kingdom. Very much of the land around Bristol is not suitable for the plough. Speaking generally, the owners profit most by allowing it to remain in its original state, either as woodland or for grazing. But although during the last half-century cultivation has not threatened to reduce the number of our plants, yet the advance of bricks and mortar in the rapid expansion of this great city wears another aspect. However, we believe that up to the present time hardly a single species correctly reported as native in our area has become extinct, though with a few existence is precarious. As an instance may be mentioned *Thalictrum minus* on Durdham Down. Known by Sole in the last century to occur in small quantity, this rare plant is now represented at Bristol by two specimens only, and these are very much at the mercy of scrambling boys whose heedless feet will one day be the cause of their decease. Another plant in danger of destruction is *Cyperus longus*, at Walton-in-Gordano. This rare and beautiful sedge has grown from time immemorial in a small plot of very wet marshy ground, believed to have been anciently a fish-pond, and situated behind some cottages in the upper part of the village. Sole, in MS. dated 1782, says of it, "Abundantly in a pond at Walton-in-Gordano, near Possit, Somerset, a village belonging to Sir Abraham Elton" (Possit-Portishead). The plant continued to be plentiful until 1882, when the occupier of the land ploughed it and planted potatoes. At the end of August, 1883, we found many stems coming up by the sides of two ditches which intersect the field, and also among the crop; but in consequence of the disturbance their development was much retarded, and flowering delayed nearly two months. Since that time, owing to the drainage and cultivation, the sedge has become reduced in quantity, and the stems produced in successive seasons have failed to come to maturity, whence it is to be feared that *Cyperus longus* will soon head our list of lost rarities.

Those botanists (but they are surprisingly few) who delight to study the critical groups of aquatic Ranunculi, brambles, and roses will find ample material close at hand. The genus *Batrachium* is so well represented in our marshy ditches and brackish pools that the majority of British forms can be recognised.

It is to the keen observation of a lady that we owe the latest discovery of a choice species—namely, that of *Blysmus compressus*—on the coast near Burnham; and, in deference to the sex, we devote the last paragraph of this imperfect sketch to a notice of the ladies' favourite order. Ferns, however, are scarce about Bristol, and are receding farther from the city since their cultivation became a fashion. If the ruthless uprooting and transference to death in a garden continue, we may bye and bye have only a few fronds of bracken left. *Cetarach* is a feature of local botany, and one of the prettiest ornaments of our limestone walls. *Cystopteris* and *Osmuuda* formerly grew in Leigh Woods; but for the first, one must now go in the direction of the Mendips, where it is frequent; and for the second, to the peat moor, on the southern limit of the district. On the peat grow also *Lastræa Thelypteris* and *L. spinulosa.* There is evidence, too, that *Phegopteris Dryopteris* once grew in Leigh Woods; the place has been pointed out, but the fern is no longer there. *P. polypodioides* is known in one spot near Wells; and the occurrence of *P. Robertiana* at Cheddar has already been alluded to. *Asplenium lanceolatum*, on sandstone rocks in Glen Frome, has, we fear, shared the fate allotted by collectors to all good things. Ten years ago it was spoken of as being only obtainable with the aid of a quarryman and a rope; and this information has since been confirmed.

But in spite of possible losses, we trust yet to add largely to our knowledge of the rich botanical resources of one of the most delightful, interesting, and exhaustless districts in the country.

NEW PROCESS OF SUGAR-REFINING.

It is singular that almost at the same time that the conference for the abrogation of the sugar bounties begins its work we should receive intelligence of a new process which seems destined to entirely revolutionise the sugar-refining industry. This method, which, after repeated testing, is said to have proved capable of accomplishing all that has been claimed for it, depends for its action upon the use of electricity. Its discoverer, Professor H. C. Friend, of New York, who died in May last, unfortunately before the realisation of its commercial success, must have been mentally characterised by an extraordinary combination of inventiveness and secrecy. He had made a careful study of electricity, and especially of its applicability to sugar-refining, for several years before his work and hopes were finally rewarded by the production of a hard sugar of almost perfect purity. It is said that he was the discoverer of quite a considerable number of useful and valuable inventions, which, on account of his extreme aversion to publicity and possible piracy, have never been disclosed or utilised for purposes of manufacture. This secretiveness was, of course, equally, if not to a greater degree, manifested in respect of his sugar-refining process, but fortunately, there was no need to conceal the product, which was fully submitted to those engaged in the sugar trade. The unanimous verdict of all who examined and tasted it was that no such sugar had ever previously been produced, and that if it were offered for sale at the same price as the other kinds nothing could compete with it. This led to the formation of a Company about four years ago, with a capital privately subscribed for of a million dollars, of which three-fifths were to be retained by the inventor as payment for his discovery and the right to work it at home and abroad. Not only were all the shares taken up, but they have since been at a premium as high as 400 per cent. Many are held in this country, especially at Liverpool and Birmingham. The large proportion of shares held by the Professor practically gave him control of the Company, and enabled him to manage matters in the secret manner which suited his disposition and which has tended to bring about the delay in practical working which has ensued. Hence, although large manufacturing premises were acquired in Brooklyn in 1886, and adapted to the requirements of the electric process, and though much of the necessary machinery had been planned and ordered two years previously to that, the internal fittings are not yet complete. The Professor had such a dread of his secret leaking out that the various parts of the machines were made, according to his instructions, at towns widely separated from one another and from New York, and the natural difficulty of fitting together the parts thus constructed was, of course, greatly increased by the fact that it had to be done entirely by the very few persons who alone were allowed to see or touch them. These persons seem to have been the Professor, his wife, and a Mr. Howard, whose knowledge of mechanical work was necessary for designing and constructing the apparatus, and in whom the Professor felt he could place complete reliance. The promoters of the Company proposed at the outset to keep the invention entirely secret, and, of course, not to patent it, as the publication of the specifications would have revealed the whole process. This intention no doubt arose in the main from the Professor's influence, as he did not even impart his secret to any member of the Company. By means of small machines constructed by Mr. Howard several demonstrations of the capabilities of his process were carried out, in which raw sugar was supplied to the Professor by invited members of the Company, and he afterwards turned it out from his machine as refined sugar of the particular size of grain that had been previously determined on and named by his visitors. Before the operation the visitors were allowed to inspect the room and to feel the machine through a cloth which was placed over it. After satisfying themselves that there was nothing in the room but the machine, the raw sugar they had brought, and the empty vessels to receive the refined product, they withdrew and waited outside the door, where they could hear the sound of the machinery in motion. After about an hour and three-quarters, they were readmitted, and in place of the raw sugar found the empty vessels filled with snow-white sugar crystals of the size they had specified.

Professor Friend's refusal to impart his secret to anyone but his wife might easily have prevented it from ever being utilised, if a stipulation had not been made, on behalf of the Company, that it should be expressed in writing and deposited with trustees, who should open it in the case of the death of both the inventor and his wife. Since his death, however, the embargo of secrecy has been so far removed that the Company have opened negotiations for disposing of the working rights in Great Britain, some of the British colonies, and in France.

In as far as the process has been permitted to be divulged, it appears to possess several remarkable features, more remarkable than would be expected from the mere use of electricity, except by those whose ignorance leads them to credit that agent with any possible or impossible kind of mysterious power. In the first place, no syrup is produced, and consequently boiling does not enter into the process; animal charcoal is also dispensed with, and through the whole of the operations the sugar is used in the dry state only. The refining process lasts about four hours; that is, the refined sugar is formed within four hours of the time when the machinery is set in motion, and is then produced continuously as long as the raw sugar is supplied. The lowest qualities of crude sugar are refined with as much ease, and as inexpensively, as those of the best quality. The quantities dealt with, which have included beetroot, Java "stoops," etc., have been from ten pounds up to over three tons at a trial, and the machinery now nearly completed is estimated to have a daily output of 500 tons. The product is described as a hard, white, crystalline, sugar, containing 99·90 per cent. of pure cane sugar—that is to say, practically of perfect purity. This result contains within one per cent. of the whole saccharine matter of the raw sugar, whether it be in the condition of cane or invert sugar and whatever its quality. Any description of refined sugar can be produced, and any size of grain. The crystalline form and structure as seen under the microscope differ entirely, it is said, from those of ordinary sugar. There are, it seems, two main divisions of the machinery—one by which a molecular transformation in the sugar is produced, and the other in which the transformed sugar is formed into crystals of the required size. This second, or granulating part seems to be that in which a difficulty has occurred in manufacturing on a large scale. This difficulty, however, is stated to have been overcome. The first division of the machinery is that which contains the Professor's chief secret, and of which he was most jealous of all. He had it established in a special strong room at the top of the building, and over the door was affixed an announcement which declared that any one venturing inside this secret apartment would meet with instant death—a threat which we are told, he had taken precautions to carry into effect.

The cost of production is, of course, one of the chief considerations to be weighed in the establishment of a manufacturing enterprise. In this respect the Electric Sugar Refining Company seems very fortunate. The cost of the refining process is not to rise above 3s. 9d. per ton, or at least the Professor's shares are to receive no dividend if that price be exceeded. By this means a profit of £4 per ton is said to be possible. The introduction into New York of the new manufacture is said to be looked forward to in the hope that it will break the great monopoly called the Sugar Trust, which controls all dealing in this article. If the anticipations of the Company be realised at least two great benefits will be conferred on sugar consumers—the diminished cost of sugar will provide a further source of cheap food, and the clear crystalline structure of the new production will greatly increase the difficulty of adulteration.

THE MAGNETIC PROPERTIES OF GASES.—According to the recent experiments of Professor Toepler, oxygen is the most magnetic of all gases; next follow atmospheric air, nitric oxide, hydrogen, and carbon monoxide.

Reviews.

Bees and Bee-Keeping; Scientific and Practical. A Complete Treatise on the Anatomy, Physiology, Floral Relations, and Profitable Management of the Hive Bee. By Frank R. Cheshire, F.L.S., F.R.M.S., Lecturer on Apiculture at South Kensington. With numerous Illustrations of the Internal and External Structure of the Bee, and its Application to Plant Fertilisation; Bee Appliances and Methods of Operation, Diseases, etc. Vol. I., *Scientific.* London: L. Upcott Gill.

To many persons, even of the "educated and respectable" classes, an elaborate work in two goodly volumes on the hive-bee will seem a surprise. But if they will take the trouble to follow the author they will, we believe, find here matter of great and varied interest. Mr. Cheshire is a man evidently familiar—practically familiar—with his subject. But at the same time he is miles apart from the rule-of-thumb bee-master of the old school. He tells his readers that "practice without intelligent insight only stereotypes; but practice, hand-in-hand with accurate knowledge and observation, works out perfection"—a principle that holds good in every sphere of industrial art. He, therefore, takes his stand upon a sound general acquaintance with insect structure and insect life, more especially that of the Hymenoptera, and most especially with the *Apidæ*, the group to which the domestic honey-bee belongs.

The account given of wild and hive bees, of the economy and general structure of the latter, and of their nervous and digestive systems, etc., is not merely accurate but has the advantage of being conveyed in intelligible language, not over-loaded with newly-coined technical terms, and is illustrated with clearly drawn figures.

A very interesting chapter is that devoted to the organs of special sense, the antennæ and the eyes. The author considers it highly probable that bees—he might have extended this proposition to insects generally—"possess modifications of sensibility which we can no more truly realise than can the blind imagine the difference between red and green." This opinion few observant entomologists will seek to gainsay. The sense of touch he refers to the tactile hairs distributed in different parts—an adaptation which we find to some extent even in vertebrate animals, *e.g.*, the whiskers of the cat. Taste he seeks for in the mouth and tongue, and also, possibly, in the nerve endings of the epipharynx. Hearing and smelling he places both in the antennæ, which he describes and figures very carefully. That these wonderful appendages are at the same time the organs of touch, as we find it to be the case in some mammalia, need not surprise us. He points out that Sir John Lubbock does not deny to bees the possession of hearing, but merely takes a negative position, his own experiments having proved indecisive. These experiments, however, the author regards as inconclusive in face of certain facts which may be observed in dealing with bees. Hence he does not deny all possible value to the "key and swarming-pan" of old times.

Facts which he mentions prove not merely the possession of smell by insects, but its localisation in the antennæ. He refers to the collection of moths by the practice of "sembling," which he has personally witnessed on Bagshot Heath. Among bees he mentions that the drones have a far more highly developed sen sory surface in the antennæ than have the workers and queens. This superior development of the olfactory organs in the male sex is what we find in many moths, in gnats, and in many beetles, and has its obvious physiological meaning. We do not find that the author refers at all to the utterly untenable hypothesis of Wolf and Graber, who actually say that "no one has proved that the antennæ of insects display any sensitiveness to odoriferous matters."

The simple eyes which bees have on the top of the head, in addition to the facetted eyes, Mr. Cheshire considers adapted for sight at short distances. The reason why some insect species possess this two-fold visual apparatus whilst others have only the large compound eyes has not been fully ascertained.

Experiments—especially those conducted by Sir John Lubbock—have shown that bees distinguish colours, and have their preferences for certain tones.

From considerations of space we are compelled to pass on to a very interesting chapter, which treats on bees as fertilisers, florists, and fruit-producers. Beginning at the end of this chapter, we find notice of a fact, little known, but equally noteworthy for its scientific interest and its practical importance. An apple, for its production in perfection, "demands no fewer than five independent fertilisations. If none are effected, the calyx, which really forms the flesh of the fruit, instead of swelling, dries and soon drops. An apple often develops, however, though imperfectly, if four only of the stigmas have been pollen-dusted, but it rarely hangs long enough to ripen, the first severe storm sending it to the pigs as a windfall. I had 200 apples, that had dropped during a gale gathered promiscuously for a lecture illustration, and the cause of falling, in every case but eight, was traceable to imperfect fertilisation."

Another very interesting fact here recorded is that some blossoms, *e.g.*, the great wild bindweed (*Convolvulus sepium*) remains open at night if the moon is shining, and thus is able to attract moths, which carry on the task of fertilisation when bees, wild and domestic, are asleep. But the whole of this chapter we can recommend for most careful study as giving excellent instances of the mutual action of insects and flowers. It is to be regretted that some persons still believe that the visits of the hive-bee, or indeed the so-called humble bee (should be *hummel* bee), to gardens and orchards are for the purpose of devouring the fruit, especially raspberries. The author is justified in saying, by way of peroration:—"The bee, with all her wonderfulness, is only one wheel within many; she takes to truly give, for seeds, flowers, and fruits follow in her train. Her honey is but a fraction of the results of her labours." Rightly does he remind us that a great part of the mischief of a bleak, ungenial season like the present is not so much the direct action of chilly winds and unseasonable frosts as of the circumstance that the bees are hindered in their work of fertilisation.

ROMAN BATH, AND RECENT DISCOVERIES.—II.

(Continued from p. 184.)

THE records of Roman life in Britain are but few, and chiefly confined to military movements and successive acts of subjugation, but we know that after the subjugation of the south and west of Britain, under the Emperor Claudius, this part of the island was not harassed by war, and seems to have developed its resources under an orderly government, as we find throughout Somerset and Gloucestershire, as well as in Wilts and Dorset, remains of fine Roman villas, situated on the lines of main roads which traversed the country in different directions. Beautifully executed mosaic pavements have been found in these villas, as at Woodchester, Lydney, Cirencester, Bath, Wellow, and places too numerous to mention. Within a radius of five or six miles around Bath fourteen or fifteen sites have been opened. Along the line of the Mendip hills abundant traces of Roman mining have been left, and many pigs of lead, bearing the Roman stamp, have been found, from the date of the Emperor Claudius to that of the Antonines. Hoards of Roman coins have also been discovered, one very lately at East Harptree, between Wells and Bristol, on the line of Roman road along the Mendip Hills, connecting the Roman port on the Severn, at the extremity of Breandown, near to Uphill, with Old Sarum, and from thence leading to the seaports on the south coast of Britain. In the district of Mendip was obtained the lead which is found so copiously used in the coating of the Roman baths at Bath and in the formation of the pipes for conveying the hot water to the baths. A pig of Roman lead bearing the stamp of the Emperor Hadrian was found in Bathwick, on the site of Sydney Buildings, and is now in the Museum of the Literary and Scientific Institution. The lead-workings in the Mendip Hills lie chiefly on the surface, and the lead ore has been entirely extracted by the Romans, as no fresh veins have been found; and lead, in more recent times, has been procured by re-smelting the Roman scoria which covers many acres, and from re-washing the old refuse from former washings, called "slimes." Coins of a very early date are found among the refuse, as well as Roman finger-rings with engraved stones.

The Roman coins found in Bath and the neighbourhood begin with the name of the Emperor Claudius, and continue to the latest period of Roman occupation. Much variety of pottery has been found, and glass, as well as bronze implements, most of which are preserved in the Museum of the Literary and Scientific Institution, though many curious articles and articles of value are known to have passed out of the city and found their way into private collections. The inscribed stones found within and around the city are not the least interesting remains to be recorded.

They consist of altars to the tutelary goddess Sul, or Sul-Minerva, and confirm the statement of the historian Solinus. She is also coupled with the "Numina Augustorum," or divinity of the reigning emperors, on one altar, and there is also a tombstone to her priest, named Calpurnius Receptus, and an altar to her attendant nymphs, called *Sulevæ*. There are seven stones which record her name. Many funereal monuments have been preserved, though many have been lost, of which a record remains.

They are some to soldiers of the 20th Legion, located at Chester. One to a soldier of the 2nd Legion, entitled Adjutrix, Pia, Felix; one to an aged *decurio* or magistrate, of Gloucester, Glevum being ranked as a *colonia*.

A stone found at Combe Down, a mile south-west of Bath, records the restoration of the officers' quarters, which had fallen into decay, another the repurgation of a *locus religiosus*, dedicated afresh to the divinity of the emperors. Among the many fragmentary remains found in clearing out the Roman reservoir into which the hot springs were received, were two small bronze tablets containing inscriptions difficult to decipher, and only one of which has been read, but variously interpreted. It seems to be either an imprecation (*defixio*) or anathema, having a list of names attached to it. Many coins and two metal vessels and other articles were also found, which are now lodged in cases in the Pump-room, but are very indifferently arranged. It would be impossible in this short notice to particularize all the objects of interest which have been discovered, but which when arranged may help to furnish a very instructive museum of Roman remains, if united with those already preserved in the Museum of the Literary and Scientific Institution.

No notice of Roman Bath can be complete without specifying the roads which led to it and the bridge by which the river Avon was crossed. The present bridge has succeeded a bridge constructed in Roman times, some indications of which still remain. The principal Roman road, called the "Foss," coming from the seacoast of Devonshire, and traceable nearly from Seaton, passed through Ilchester, a well-known Roman station (Ischalis), continued on until it crossed the Mendip Hills near Shepton Mallet, and afterwards approached Bath by what is still called "Holloway," below which it crossed the river Avon and entered Bath by the south gate.

This road is laid down on the ordnance map, and remains perfect in many places, having recently been examined and its structure recorded. It passed through the city by the north gate, now destroyed, but the mediæval gate seems to have incorporated the Roman gate in its structure, if you can trust the drawings that remain. From this point it passed through the suburb of Walcot, and its course has been traced by the remains of Roman interments and memorials which have been found along its course, until it came to Bath-Easton, where it ascended the hill and made direct for Cirencester, the ancient Corinium. The course thither is distinctly traceable past the *shire-stones* which mark the contact of the three counties Somerset, Wilts, and Gloucestershire. It afterwards continued its course to Lincoln (Lindum), and from thence to the sea.

Another line of Roman road came from South Wales. Leaving the Roman stations of Caerleon and Caerwent, well known as the location of the "Legio Secunda Augusta," it crossed the Severn above its junction with the Avon, and came on to Bitton, where are distinct remains of a Roman station, and from thence entered Bath, passing through Weston and entering by the west gate of the city. It united its course with that of the Foss until it came to Bath-Easton, where it branched off and passed up the hill to Bathford, and continued its course straight to Marlborough (Cunetis), and so on to Silchester, the ancient Calleva.

These were the *main roads* in Roman times, but others, of inferior construction, have been traced.

A principal road came from Gloucester (*Glevum*), which united with the road commonly called the *Via Julia* not far from Bristol, and so passed on to Bath. The Roman town of Bath was thus connected with all the principal stations in the west of England; and though there are no lapidary records by means of which we can ascertain by what troops the city was garrisoned, or any stamped tiles such as are found at Caerleon, bearing the impress of a particular legion, yet there is no doubt that Aquæ Solis was fortified and held by Roman troops.

The tombstones that are found record the names of legionary soldiers, both infantry and cavalry, also of centurions, but these may have come for the benefit of the thermal springs, and have died in Bath.

Remains of Roman camps exist on Lansdown and on the Bathwick side of the river, which seem to have been occupied as summer stations.

Very interesting remains have been found at Camerton, on the Foss Road to the south-west of Bath, which appears to have been a Roman posting-station, and remains of many houses have been found there, as well as the foundations of a semi-circular building. Many coins have also been found here, which were collected and recorded by the Rev. J. Skinner, a former rector.

Those members of the British Association who visit Bath at the approaching meeting and are interested in the Roman remains will find ample opportunity of gratifying their taste, and will also find every facility, as a handbook has been prepared specially for the visitors, giving complete details of the city and its surroundings.

MEETING OF GERMAN NATURAL PHILOSOPHERS AND PHYSICIANS AT COLOGNE.

At the last meeting of the Society of Natural Philosophers and Physicians in Wiesbaden, in 1887, a resolution was passed appointing Cologne as the centre for the sixty-first meeting of the Society, and, thanks to the untiring activity of the several committees and the co-operation of the Town Council, preparations for the reception of the guests are well advanced.

The Wallraf-Richartz Museum, the Museum of Industrial Arts, the Historical Museums, and the Rathhaus (Council Chambers), in Cologne, will be opened free to members on production of their cards, at any time during the week of the meeting.

There will be three general meetings, on the 18th, 20th, and 22nd September, in the large Gürzenich Hall; the meetings of the thirty sections from the 18th to the 20th September will be held in the halls of the Grammar School (Kreuzgasse 2-4), and of the Girls' High School (St. Apernstrasse 53-59).

Tickets for members and non-members (as well as ladies), and for the banquet (5 marks each) will be for sale at the Enquiry Office, from the 1st to the 12th September. Members are recommended to bespeak their apartments early.

The committee hopes for a large attendance of natural philosophers, physicians and friends of science, and will endeavour to accord them a fitting reception.

All communications referring to the sections must be addressed to the chairman of such sections; those concerning the exhibition must be addressed to the secretary of the exhibition committee, Herrn Dr. Eltzbacher, in Cologne, Sachsenhausen 9.

Foreign members can obtain their tickets in advance by applying to Herrn Banquier Moritz Seligmann, Kasinostrasse 12 and 14; 12 marks must be sent for members, 6 for a lady's ticket.

Herr Th. Deichmann has very kindly arranged that all the offices are to be in close proximity to the central station; the reception, boarding, and enquiry committee are all located at No. 6, Bahnhofstrasse. These offices will be open on the 16th September and following days, from 8 a.m. to 8 p.m. The necessary cards, badges, for the members and their ladies, the programmes of the meetings, the daily papers, etc., together with the tickets of the banquets, theatre, and Rhine excursion, will all be obtainable at the enquiry offices.

The boarding committee will supply all necessary information about apartments.

Abstracts of Papers, Lectures, etc.

IRON AND STEEL INSTITUTE.

The autumnal meeting of this Institute was opened at Edinburgh on the 21st inst. by the Lord Provost, who said that on the part of the Municipality he had the greatest pleasure in giving them a very hearty welcome to the ancient city of Edinburgh. His predecessor in office was once asked what was the principal industry of Edinburgh. He (the late Sir George Harrison) answered that it was education. If that was true at the time in question it was still more true now; and Edinburgh was a great resort from all parts of the world for educational purposes. What he would like particularly to bring before them was this, that in all their large schools in the city technical education formed a very important part of the instruction. He did not know that there was a large school in Edinburgh, either private or public, in which there was not a very large technical department, and during the last two or three years the old institution of Heriot's Hospital—a building which, he was sure, those of them who were strangers to Edinburgh would be glad to see, as being not only notable architecturally, but educationally—had been re-modelled, and in unison with the Watt College combination, had added very much to the technical instruction carried on in the city. First of all and foremost, however, they had now a Professorship of Engineering in the University, and, fortunately, also, they had a Professor of Engineering who devoted all his energies to the advancement of engineering. Quite recently, he was glad to say, Professor Armstrong had been fortunate enough to obtain a very large legacy from a citizen of Edinburgh, who lately died; and he had no doubt that, in a short time, and through that legacy, the material used in the department for the purposes of instruction would be augmented in a very important manner.

After Mr. Daniel Adamson, the President, had replied on behalf of the members of the Council and of the members present, the members adjourned to the Examination Hall, where the business of the Institute was conducted.

The President, on taking his seat, said that in the first place the Council had unanimously chosen Sir James Kitson, of Leeds, to be the president of the Institute for the two succeeding years. He thought it was a fitting thing that a gentleman connected with the old Yorkshire iron industry should be appointed to that position. The members would be interested in learning that the autumnal meeting of 1889 was to be held in Paris.

After the minutes of the last meeting had been read and approved, the President read a paper—"On a horizontal compound lever testing machine of 15,000 powers, with further recording lever of 15,000 powers." The machine was composed of one strong box framing, and being self-contained, only required a very light foundation, the object being more especially to prevent vibration, which might destroy the high sensitiveness of the machine when testing with great delicacy. The quadruple levers are enclosed in a box having glass sides, so that the operation might be seen, and in order to note the force by the floating weights on the fourth or registering lever. After giving a technical description of this valuable machine, Mr. Adamson concluded by saying that he did not claim to be the author of the multiple lever testing machine. In the earliest investigations, a single lever was used, the load being measured by suspending 56lb. weights, and when the full load was put on the specimen instant rupture followed, the load not being capable of being reduced as the breaking elongation took place. This latter principle was made known by him in a paper which he read before this Institute at Paris in 1878. The American "Emery" machine now being exhibited in London was also a multiple lever apparatus, but it had two hydraulic chambers with reducing areas, as 1 is to 20—the lever system being as 1 is to 20,000—making the total ratio of the hydraulic chambers and the lever system together as 1 is to 400,000; and it was reported that the motion of one-millionth of an inch on the specimen produced a motion of the indicator rod o four-tenths of an inch. This high indicating power would be found of great value in noting the amount of force necessary to produce permanent set. The earlier tests made by Mr. Kirkaldy, in Glasgow, were with a single lever machine, but he no doubt saw the necessity of greater accuracy and higher refinement. Mr. Adamson believed that Mr. Kirkaldy was the first to adopt the multiple lever system, and his tests were taken as the standards of accuracy by the whole of the professional community.

Sir Lowthian Bell (who presided during the discussion on Mr. Adamson's paper) said his recollections of the iron industry of West Yorkshire extended back for many years. In those early times no manufacturer thought of employing a testing machine on his own premises. Now, however, it was necessary for a manufacturer of any pretentions to have such a machine. The qualifications of testing machines involved not only great accuracy of performance, but, owing to the amount of work to be done by them, they must be of such a construction as to enable those entrusted with them to do the greatest amount of work in the shortest possible time. He believed that no one had contributed to popularise the use of testing machines more than Mr. Adamson.

Mr. R. A. Hadfield (Sheffield) then read a paper on manganese steel. He said that it would hardly have been thought probable that the ordinary properties and nature of the metal iron could be so completely changed as it is now known to be by its alloy with a second metal, manganese. This new steel had drawbacks that at present interfered with its usefulness and commercial introduction. The chief one met with was its hardness. The majority of articles used in machine construction of any kind must be tooled, fitted, or adjusted to shape, and this was almost out of the question with this material—in fact, in its machining it might be described as equal to the hardness of chilled iron. No doubt, by experiments and perseverance, this and other difficulties would be overcome, and possibly this very drawback might eventually prove a blessing in disguise, inasmuch as should some better method of machining or finishing be perfected it should be equally beneficial to all branches of engineering. He briefly described the early history of manganese, ferro-manganese, and the manufacture of ordinary steel, observing how much the world at large has been indebted to the early experimentalists with that now all-important metal manganese. Mr. Hadfield described in detail the experiments on manganese steel, remarking that this material is not so liable to honeycombs as ordinary steel, and the addition of silicon is unnecessary. It is very fluid, and can be run into thin sections, but cools more rapidly than ordinary steel, and its contraction is decidedly greater. It is manufactured by any of the ordinary steel-making processes, the basis, *i.e.*, the material before the ferro-manganese is added, being preferably decarbonised iron (practically pure iron, Fe) or mild steel. The ferro-manganese is added in a molten state, or very highly heated. The steel is then ready for casting into ingots or other forms. It is most important that the carbon should be kept as low as possible, especially in the 14 per cent. material, where it should not exceed about 1 per cent., or the product will be inferior. For this reason, the ferro-manganese used should contain high percentages of manganese, such as 80 to 84 per cent., now easily procurable at as low a price as £9 per ton. About 0·50 per cent. of the manganese is oxidised—that is to say, to obtain a steel with about 13 per cent. about 13½ per cent. of manganese must be added. It will be readily understood that the ordinary crucible steel-making process is not suitable for the making of this manganese steel, on account of the manganese cutting or slagging the pots. He then proceeded to give a more exact description of the qualities of the material. Referring to its peculiar hardness, he said it was somewhat difficult to describe this quality, because all the specimens are exceedingly hard—in fact, it is scarcely possible to machine any of them on a practical scale. Yet such hardness varies considerably in degree, being most intense in the cast material containing 5 to 6 per cent. of manganese which no tool will face or touch. A slight decrease then occurs, and the 10 per cent. material gives comparatively the softest condition. Upon a further addition of manganese an increase again takes place, and at 22 per cent. it is very hard, though still not so much so as in the 5 per cent. material. It was difficult to explain the cause of this hardness, because manganese, when added to copper, does not produce this remarkable change, and why, therefore, should manganese added to iron, which in its pure state is but little harder than copper, produce such a hard alloy? Apparently iron must have some property of changing its form in a way not yet understood. As bearing upon this point, a well-known metallurgist, Mr. John Parry, of Ebbw Vale, said in an article on "Spectroscopic Analysis of Iron and Steel," that in his opinion the search for and determination of substances technically termed impurities in iron and steel is nearly over; we have little left for research except the iron itself. It was possible therefore that in this direction a clue might be furnished to many as yet unresolved problems, and possibly in the manganese steel there is some change in form of the iron itself. Manganese steel, notwithstanding its high proportion of metallic iron—the most magnetic metal known—possesses the peculiar property of being almost entirely non-magnetic. Rinmann, as far back as 1773, noticed that manganese alloys gave non-magnetic material. This was also noticed by Mr. David Mushet about 1830. This Dr. Hopkinson suggested that the mangenese in the steel was not merely mixed mechanically with the iron, but that it entered into the molecule in such a way as to destroy its magnetic properties, which are the same in either its cast or forged, hard or toughened state. Another peculiar physical characteristic of manganese steel noticed by Professor Barrett was as follows:—Some years ago he discovered that when iron or steel heated to whiteness was allowed to cool in a dark room, the moment the temperature of the steel reached obscurity a sudden revival of temperature occurred, an outward rush of heat taking place, and the steel glowing again red hot. This afterglow or recalescence, which occurred in all ordinary steel, did not take place with this material, as was the case in other non-magnetic metals, such as platinum, silver, copper, etc. In some recent experiments it had been noticed that drillings of 20, 30, and 36 per cent. manganese steel, which were practically unattracted by the magnet, after being heated to redness and allowed to cool, exhibited a considerable increase in magnetic susceptibility. This occurred even when the drillings were heated and cooled in hydrogen. The fact stated could scarcely be due to oxidisation of the manganese owing to heat, because the weight before and after the experiments was the same. In conclusion, he said it was not possible within the scope of a paper to deal with the many interesting points raised by the peculiar qualities of manganese steel. His hope in bringing this matter before the Iron and Steel Institute was as stated by Mr. Howson, when addressing the Cleveland Institute of Engineers last year: "Individual effort, although exerted in the most useful direction, is often of but small account when taken alone. It is only when submitted to the scrutiny of many minds, and freely discussed, that it proves of real value." He hoped it might be so in the present instance.

In the course of the discussion, M. Gautier described experiments made in France in the application to practical uses of manganese steel. The first application, he said, was in the direction of making horse-shoes. The alloy contained 12 per cent. of manganese. But a difficulty was found in the fact that if nails of the same material as the shoe were used for fastening on the shoes, no file could be found of sufficient hardness to operate upon them. Nails, however, of ordinary steel were used without any practical disadvantage, when the heads were embedded below the surface of the harder metal. Experiments on a large scale were being made with some regiments of French cavalry. Some success had attended the casting of wheels of manganese steel for small mining cars. The difficulty they found was to withdraw the castings rapidly enough out of the moulds, because, as stated in the paper, the manganese steel was much improved by softening in water. It was a curious fact that that which was a hardening process for other metals was a softening process for manganese alloyed with iron. The difficulty was to put it into the water quickly enough and at the proper temperature; the cast wheels when extracted from the moulds shrinking, if the extraction was not done rapidly. To overcome this was, however, a question of practice. Then experiments were being made in the manufacture of armour plates. The difficulty here was the management of heavy weights of the steel. They found also that the manganese steel which they made contained too large a percentage of carbon, and some cracking occurred when the plates were dipped into water. They would, he believed, soon be able to manufacture a better quality of steel, which would resist the impact of the shells. The shell was broken, but the plate also was broken and cracked, and two or three shots brought it down. He should be glad at the next meeting of the Institute to give more information on this practical question.

In the afternoon a visit was made to Leith Harbour and Docks, down the north sides of the Albert and Edinburgh Docks, round the east end, and up the south, to North Leith Station, where the train for Edinburgh was joined.

On the 22nd, the first paper read was on "The Forth

Bridge," by Mr. F. E. Cooper, M.I.C.E., resident engineer. After a reference to the Forth Bridge as a most important link in railway communication, he said—The total length of the viaduct will be 8,296 ft., or nearly 1⅝ mile. There are two spans of 1,710 ft., two of 680 ft., and fifteen of 168 ft. girders, four of 57 ft., and three masonry arches of 25 ft. The clear headway for navigation will be not less than 150 ft. for 500 ft. in the centre of the 1,710 ft. spans. The extreme height of the structure is 361 ft. above, and the extreme depth of foundations 91 ft below the level of high water. There will be about 53,000 tons of steel in the superstructure of the viaduct, and about 140,000 cubic yards of masonry and concrete in the foundations and piers. The main piers, three in number, consist each of a group of four masonry columns, faced with granite, 49 ft. in diameter at the top and 36 ft. high, which rest either on the solid rock or on concrete carried down in most cases by means of caissons of a maximum diameter of 70 ft. to the rock or boulder clay, which is of almost equal solidity. The stresses to be provided for are those arising from the weight of the structure itself, the rolling load, and wind, as well as from change of temperature. The rolling load has been taken as one ton per foot run on each line of rails over the whole structure, or a train on each line, consisting of 60 short coal trucks of 15 tons each, headed by two locomotives and tenders, weighing in the aggregate 142 tons. The wind pressure provided for is a pressure of 56 lbs. per square foot, striking the whole or any part of the exposed surface of the bridge at any angle with the horizon, the total amount on the main spans being estimated at nearly 8,000 tons. The material used throughout is open-hearth, or Siemens-Martin steel. That used for parts subject to tension is specified to withstand a tensile stress of 30 to 33 tons to the square inch, with an elongation in 8 in. of not less than 20 per cent.; that subject to compression only a tensile stress of 34 to 37 tons per square inch, with an elongation in 8 in. of not less than 17 per cent. Strips of each class 1½ in. wide are to bend cold round a bar, the diameter of which is double the thickness of the strip. The tensile strength of the rivet steel is 26 to 30 tons per square inch. The superstructure of the main spans is made up of three forms of double cantilevers resting on the three piers before mentioned. Those on the shore sides are 1,505 ft, and that on Inch Garvie (an island fortuitously dividing the deep water space into two channels of nearly equal width) is 1,620 ft. in length. The effective depth over the piers is 330 ft. and at the ends 35 ft. The centre portions of the two 1,710 ft. spans on each side of Inch Garvie are formed by two lattice girders 350 ft. in length and 50 ft. deep in the centre, and 37 ft. deep at the ends.

Mr. T. G. Clark, of New York, said the work was of such a novel nature, so different from anything which had ever been done before, that one felt extreme modesty in giving an opinion at all. The point, he thought, which would strike the visitor for the first time would be that the bridge was not only a very strong bridge, but that it looked very strong. It carried to the eye that appearance of stability which every bridge ought to have. When they looked at the bridge, they would see that it was a great object lesson in the mode of calculating the strains upon frame structures. Everything was done in a plain and common-sense manner, and the great difference between the Forth bridge and all other bridges of British construction was the fact of the great concentration of material along the lines of strain, the object being to expose as little surface as possible to the enormous force of the wind. It would not be possible to appreciate the architectural features of the bridge until the scaffolding was removed, but when that was done he believed it would be said that the structure was one of the finest pieces of architecture in the world.

Mr. Wrightson (Stockton-on-Tees) said he thought one of the features which ought to be recognised in this great engineering work was the immense leap forward which it represented in building practice. There was another bridge crossing the East River in New York, which approximated to the span of the Forth Bridge, but that bridge, wonderful though it might be, was merely an extension of the suspension principle so well known in bridge work, whereas this was, as he had said, a leap forward of a very remarkable character. He did not think there was any bridge of cantilever structure which approached even half the span of the Forth Bridge. It was always a very interesting thing to watch any sudden leap forward in engineering practice, but, as a rule, they found that the most successful works were carried out by a gradual movement forward, and not by these sudden leaps.

A paper giving a description of a new pyrometer by Professor J. Wiborgh, School of Mines, Stockholm, was read by the secretary. It was stated that compared with measures of temperature of the same sort that had previously been used, this new air pyrometer had several important advantages, as it was of a simpler construction and could be handled by a common workman.

A paper by Professor Crum Brown (of Edinburgh) on the chemical processes involved in the rusting of iron was read by Dr. Gibson. The writer of the paper said his attention was first called to the subject by observing what happened when a drop of rain fell on a clean, bright surface of iron. At first for a short time the drop remained clear, and the bright surface of the iron was seen through it; but soon a greenish precipitate formed in the drop, and this rapidly became reddish-brown. The brown precipitate did not adhere to the iron, but was suspended in the water, and became a loosely adhering coating only when the water had evaporated. In speaking of rusting he meant the formation of rust on the surface of metallic iron exposed to ordinary atmospheric conditions. It had been conclusively shown that the necessary conditions for the production of rust are—1st, metallic iron; 2nd, liquid water; 3rd, oxygen; and 4th, carbonic acid; both the latter being dissolved in the the liquid water. Iron remained quite free from rust in an atmosphere containing oxygen, carbonic acid, and water vapour, so long as the water vapour did not condense as liquid water on the surface of the iron. He then considered the action on iron of the three substances —liquid water, oxygen, and carbonic acid. The continuation of the process of rusting was not dependent on new carbonic acid absorbed from the air, but the original carbonic acid, if not removed, could carry on the process indefinitely as long as liquid water was present and oxygen was supplied from the air. Once the process was started, it went on more rapidly, because the porous rust not only did not protect the iron, but favoured by its hygroscopic character the condensation of water vapour from the air as liquid water. A piece of iron, therefore, which had begun to rust would continue rusting in an atmosphere not saturated with water vapour, an atmosphere in which a piece of clean iron would not rust, because liquid water would condense from such an atmosphere on the hygroscopic rust, but not on the bright iron.

The Secretary read a paper by Mr. W. J. Millar, C.E. (Glasgow), on the subject of the Glasgow coalfields, in the course of which he stated that the order of superposition and the average thickness of the coal seams in the neighbourhood of Glasgow to the eastwards are as follow:—Upper coal from 2 ft. to 5 ft. thick; ell coal from 5 ft. to 7 ft. thick; pyotshaw coal from 2 ft. 8 in. to 4 ft. 6 in. thick; main coal from 3 ft. 6 in. to 4 ft. 8 in. thick; humph coal about 30 in.; splint and virgin coal from 5 ft. to 7 ft.

In the afternoon a large number of members of the Institute left the city for the purpose of visiting the Forth Bridge.

On August 23rd about 500 members visited the Glasgow Exhibition, where they were hospitably entertained by the President of the Exhibition and the Reception Committee.

Halifax Scientific Association.—A party, on August 11th, under the guidance of Mr. James Spencer, visited the railway cutting at Netherton Bridge. It is crossed in an easterly and westerly direction by a great "fault," or dislocation of the strata, whereby the strata below the bridge is depressed about 48 yards below the corresponding beds above the bridge. This dislocation of the strata can be traced in a westerly direction by Illingworth Church, across Wheatley Valley and New Delight, into Luddenden Dean; and in an easterly direction by Shibden Head Pit to Brackenbeds. Another fault was pointed out running along the hillside from Netherton to Catherine Slack, and across Shibden Dale to Barehead, where it meets another great fault, which runs in a north-westerly direction from Coley Church, by Shibden Head Pit to Bradshaw, intersecting the Illingworth fault at Shibden Head Pit. Upon reaching Shibden Head Pit, Mr. Spencer pointed out specimens of nodules which are found in the hard-bed coal, and which sometimes contain specimens of fossil plants in a beautiful state of preservation. Some of these specimens were examined by the party, and explained by the guide, as were also specimens of "baum pots" containing marine shells.

Thirsk and District Naturalists' Society.—On August 20th the monthly meeting of this Society was held, Mr. R. Tennant presiding. Mr. Wm. Foggitt, botanical secretary, exhibited numerous specimens in his department which had been gathered in the locality. Mr. Robert Lee, vertebrate secretary, showed some very fine stuffed birds; he also gave some particulars respecting the sand-grouse, a native of Central Asia, several of which visited this country about twenty-five years ago, but had not been seen since until the present year, and recently they had been noticed in various parts.

Middlesex Natural History Society.—The members of this Society assembled on August 18th, at Edgware, under the directorship of Mr. Sydney T. Klein, and proceeded through the town of Edgware to the old church at Whitchurch, where the Rector most freely explained the various objects of interest, viz., the beautifully painted ceiling, the tomb of the Duke of Chandos and Buckingham and family, the organ upon which Handel played when he held the appointment of chapel-master, and in the churchyard the tomb of the harmonious blacksmith. Canons Park, formerly the seat of the Duke of Chandos, was also visited, Brockley Hill being reached by the old Roman road of Watling Street, where the site of the Roman town of Sulloniacæ was inspected. The members were then taken through private grounds to examine the obelisk of Cassivelaunus, a Roman encampment, two ancient barrows, one in course of being opened, and a facsimile of Rousseau's tomb.

Leeds Naturalists' Club and Scientific Association.—At the meeting held on Aug. 20th, Mr. John Stubbins, F.G.S., F.R.M.S., presiding, Mr. Oswald Dawson showed the following shells taken in the immediate vicinity of Leeds:—*Planorbis corneus, Limnæa stagnalis, L. vortex, Helix rotundata, Pupa umbelicata, Clausilia rugosa, Cochlicopa* (*zua*) *lubrica.* Mr. W. Kirkby exhibited the following plants from Grange and district:—*Epipactus palustris, Climatis vitalba, Polypodium calcarium, Myrica Gale,* in fruit; *Rhamnus frangula,* in fruit; *Andromeda polifolia, Rhyncospora alba, Geranium pusillum, Clavaria cineria.* Mr. J. W. Addyman also showed the following plants: *Sonchus arvensis, Angelica sylvestris, Hypericum hirsutum, Eupatorium cannabium, Gymnadenia Conopsca, Galium palustre, Epilobium hirsutum, E. montanum, E. parviflorum, Lactuca muralis, Sparganium ramosum, Alisma plantago, Stachys sylvatica, Chrysanthemum odorum, Betonica officinalis, Potamogeton perfoliata.*

Falmouth Naturalist Society.—This Society held its fifth field meeting on Friday, 24th inst., at Perran Wharf Valley. The party left Market Strand, Falmouth, and after a pleasant drive reached Sticken Bridge, where they were met by Mr. T. J. Porter (of Perran Wharf), who kindly pointed out the various objects of interest *en route* to Ponsanooth. Several elvan courses exist within a radius of a few miles of this neighbourhood. The first runs through St. Gluvias' parish, Penryn, and appears again at Mylor. This elvan is coarse-grained, and contains a large quantity of mica. At St. Gluvias it is about 4 ft. wide, dips 40 degs. S., and is very soft and porphyritic. The next elvan is in the granite at Penvose, from whence it runs on to Enys, where it is crossed by another from Treleaver. It is a hard fine-grained quartzo-felspathic rock, with patches of mica, and a few crystals of felspar. Another elvan may be seen on the shore at Carclew. It holds the same course as the one at Carnon Gate. Two elvans have also been quarried beyond Perran Wharf, at Carnon Gate; crystals of felspar, changed to kaolin, and mica, are distributed through them. Towards the back and sides of these elvans, isolated blocks of a harder quartzo-felspathic rock, with a greenish base, and crystals of felspar abundantly occur. The slate between this place and Restronguet Bar is very much contorted, forming anticlinal ridges and beds of a soft yellow sandstone from 6 ft. to 20 ft. wide. About two miles north of Penryn, an elvan has been quarried, and cut through by the railway, near the bridge, on the Truro road. It is a branch of the elvan found in the granite at Trelince. At the cutting it is in slate between granite and greenstone, which it cut through. It is very hard, and has a basis of fine-grained quartz, and felspar in places, containing small plates of mica.

CORRESPONDENCE.

The Editor does not hold himself responsible for opinions expressed by his correspondents, nor can he take notice of anonymous communications. All letters must be accompanied by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

BALLOONING.

In the *Freeman's Journal* of the 22nd inst. there is a leader on balloons. It is a very interesting article, and ends up by saying that "before long these airy speculations will have assumed a very practical form indeed," meaning we shall soon be able to navigate the air successfully. There are a large number of readers of your valuable and clearly-written paper, I am sure, who would be glad to see a few good articles in the SCIENTIFIC NEWS on the subject.

Some say to even think of "aerial navigation" is absurd; and others condemn balloons altogether, and advocate "flying machines." One of your correspondents gave a very plain hint a short time ago that he possessed exceptional knowledge of the subject.

Should England be the first to become "master of the air" as well as being "mistress of the seas," her lease of life would be indefinitely extended, and the sketching visit to the ruins of London of Macaulay's New Zealander would be at once deferred to the *very* dim and distant future.

Hoping for information from you or your correspondents on the subject. W. P. W.

PRESCRIPTION FOR MOSQUITOES.

I notice in your journal of 17th August prescription for mosquitoes. You say, "We should also be happy to learn whether 'F. B.'s' mixture is better than tincture of '*Ledum palustre.*'" Will you please inform me what this is, and give me some particulars of it, as, having travelled nearly all over the world, I never heard of its being used as an antidote for mosquito bites or a protection from the same. By far the best thing I know of is a preparation from the Margossa tree of Ceylon, which, except from the scent, is unobjectionable, whereas being coated, as "F. B." recommends, with Stockholm tar would be more objectionable than being bitten, I should say. A. BROWN.

55, Woolwich Common, August 21st, 1888.

[The Marsh Rosemary, *Ledum palustre*, otherwise known as Labrador tea, is a shrub growing to the height of 3 ft. or 4 ft. It grows in swampy districts in the north-west of Ireland and Scotland, in the countries around the Baltic, in Siberia, and the Dominion, especially Labrador. The alcoholic extract of its leaves has a very peculiar but not absolutely disagreeable smell. If it be diluted with water and applied to the skin, no sand-fly, mosquito, etc., will, to the best of our knowledge, settle on the person thus protected. We have heard of this remedy and of its efficacy so long that we do not remember who first discovered and applied it. Mr. Brown is right concerning the disagreeableness of "F. B.'s" lotion; but we must remember after all that the bite of a mosquito may mean the injection into the system of the poison of yellow fever or of malaria.—ED. SCIENTIFIC NEWS.]

PETALS OF THE WHITE JASMINE—FERTILISATION OF FLOWERS.

In reply to "Scrutiny" I would observe that the genus *Jasminum* has long been noticed as varying in the number of petals. If I remember rightly, Dr. Lindley gave a series of diagrams in his "Botany for Ladies," but such variations are extremely common in many flowers, as, *e.g.*, *fuchsia*, elder, loosestrife, members of the *Alsineæ*, etc., in which the sepals, petals, and stamens may all vary together. In my work on "The Origin of Floral Structures" I have suggested that it may simply result from nutrition, which brings about such "symmetrical increase or decrease;" so that if a 5-merous state be normal, an excess will produce a flower with say 6-merous whorls; while a deficiency results in a 4-merous one.

With regard to "L. H. A.'s" observations on the flowers of tobacco and evening primrose not being fertilised, the tubular structure of the calyx in the latter, and of the corolla in the former, points to insects with long proboscides as visitors; but as neither plant is indigenous to Great Britain, it is possible that they have not met with a suitable insect; just as *Sphinx convolvuli*, being a comparatively rare insect here, *Convolvulus sepium* seldom sets any seed in our hedges.

I should like to take this opportunity of correcting a misprint in my article on the "Formation of Ice." (SCIENTIFIC NEWS, vol. ii., p. 189). Instead of "*angle of* 30 degs." it should have been 60 degs. or 120 degs.

GEORGE HENSLOW.

ANSWERS TO CORRESPONDENTS.

LEOPOLD VINNING. — The original statement is correct. Pressure per square foot is not the same as overturning force, into which leverage enters. The remarks about leaping apply equally to lifting by the hands.

ANNOUNCEMENTS.

WHITWORTH SCHOLARSHIPS.—The Department of Science and Art of the Committee of Council on Education notifies that the following candidates have been successful in the competition for the Whitworth scholarships of the value of £125 a year (tenable for three years).—James Whitaker, student, Nelson, Lancashire; James Mair, engineer, Glasgow; C. Humphrey Gilbert, engineer student, Nottingham; and John Calder, mechanical engineer, Glasgow.

Exhibitions (tenable for one year) of the value of £100 have been obtained by Harry Bamford, engineering student, Oldham; John Harbottle, draughtsman, Newcastle-on-Tyne; John Taylor, engineer, Glasgow; John Dalglish, mechanical draughtsman, Paisley; Archibald S. Younger, engineer student, North Shields; Joseph Butterworth, engineer, Rochdale; George A. Burls, mechanical draughtsman, Greenwich; Charles H. Kilby, engineer apprentice, Crewe; Charles R. Pinder, engineer student, Bristol; Robert Dumas, engineer, Glasgow; Charles L. E. Heath, fitter apprentice, Devonport; Charles Forbes, engine fitter apprentice, Glasgow; Benjamin Young, electrical engineer apprentice, Belfast; Edward Y. Terry, engine fitter, Devonport; William J. Collins, draughtsman, Woolwich; John H. B. Jenkins, assistant analytical chemist, New Swindon; John I. Fraser, apprentice engineer, Glasgow; Henry E. Cheshire, fitter, Crewe; Oscar Brown, pattern maker, Plumstead; Henry Elliott, mechanical engineer, Glasgow. Exhibitions of the value of £50 have been won by James H. Binfield, engineer student, Preston; George U. Wheeler, engineer apprentice, London; William Day, fitter, Wolverton; Samuel Lea, turner, Crewe; Evan Parry, engineer student, Bangor; Thomas O. Mein, engineer, Stratford, E.; Benjamin Conner, apprentice engineer, Glasgow; Thomas J. Bourne, marine engineer, Tunbridge Wells; George Ravenscroft, fitter, Crewe; Thomas F. Parkinson, engineer student, Bury, Lancashire.

The following is a list of successful candidates for the National Scholarships: John B. Coppock, student, Nottingham; James G. Lawn, mining surveyor, Barrow-in-Furness; Herbert Grime, teacher, Manchester; Alfred Stansfield, student, Bradford; John Eustace, engine fitter, Camborne; Edwin Wilson, student, Bradford; Lionel M. Jones, student, Llanelly; Joseph Jefferson, student, Bradford; Henry T. Bolton, student, Newcastle-on-Tyne; Ben. Howe, student, Manchester; John Yates, draughtsman, Manchester; Harry Cavendish, student, Manchester; Thomas S. Fraser, laboratory assistant, Glasgow. Royal Exhibitions have been obtained by Benjamin Young, electrical engineer apprentice, Belfast; James Harrison, shoemaker (riveter), Northampton; John D. Crabtree, student, Bradford; Joseph Burton, student, Manchester; John Taylor, engineer, Glasgow; Joseph Husband, student, Sheffield. Thomas Beatham, student, Newcastle-on-Tyne; Charles H. Kilby, engineer apprentice, Crewe; George H. Gough, student, Bristol; Henry E. Cheshire, fitter, Crewe; Ernest W. Rees, engineer apprentice, Carnarvon; Stanley H. Ford, student, Bristol; have secured Free Scholarships.

RECENT INVENTIONS.

The following list has been compiled especially for the SCIENTIFIC NEWS *by Messrs.* W. P. THOMPSON *and* BOULT, *Patent Agents, of* 323, *High Holborn, London, W.C.; Newcastle Chambers, Angel Row, Nottingham; Ducie Buildings, Bank Street, Manchester; and* 6, *Lord Street, Liverpool.*

SURGICAL SPLINTS.—Improved surgical splints have been patented by Mr. J. Mayer. These splints are made of papier-mâché, as thin as is compatible with strength, and are perforated to afford means of escape for offensive matter, and also for ventilation. These splints combine lightness, strength, and impermeability to moisture.

CLEANSING POWDER.—A cleansing powder has been patented by Mr. J. W. Paton. It is composed of carbonated soda, ash, and precipitated carbonate of lime. The powders are thoroughly mixed together in suitable quantities, and passed through a fine sieve. They are then packed ready for sale, and may be used as a polishing powder or paste, and for cleansing floors, marble, metal, and such like.

FOLDING BATH.—A folding bath for use at the side of a floating structure has been patented by Messrs. G. Sparrow and W. S. Kelly. The bath is constructed with its bottom consisting of a framework supporting a grating, and connected by rods to a platform constituting the top of the bath, from which the bathers enter the water. At the sides and ends the structure is enclosed by netting. The bath is attached to the floating structure by hinges, and is connected to a winch, by which means it may be folded up and made to assume a vertical position.

PHOTOGRAPHY.—An apparatus for washing photographic prints has been patented by Mr. E. H. Lyne. The apparatus consists of a pipe which conducts a spray of water on to the prints in a tank until the tank is filled. A self-acting regulator is provided for the water, and comprises a ball and plug; when the water in the tank reaches the desired height, it raises the ball which lifts the plug, thus allowing the water to run off, leaving the prints in the tank. As the water lowers, the plug is replaced, and the tank is again filled and the operation repeated continuously.

CLEANING BOOTS.—Mr. G. H. Cable has patented an apparatus for cleaning boots. From a base projects a stand on which a boot can be placed to be cleaned. Also from the base extends upwards a bracket having a swan neck projecting over the heel part of the stand. Through a socket at the end of this neck passes a sliding bar which can be lowered or raised. When lowered it is pressed down by a lever fixed by a screw. The bar being fixed, a boot is placed on the stand, the bar is slid down, its foot pressing on the inside sole, and there fixed by the lever and screw. The boot is thus firmly held in position while being cleaned.

ELECTRIC LAMPS.—An electric lamp attachment has been patented by Mr. W. Hartnell. The object is to provide means for placing and retaining a reflector surrounding an electric lamp in different positions so as to throw the light accordingly. This is accomplished by supporting the reflector, and the lamp also when possible, [illegible]itable attachments such as will permit them to [illegible]on a transverse axis passing through the centre of gravity of the pieces to be moved, and at the same time leave the whole free to turn upon another axis at right angles to the first, provided on a fixed support. This removes any tendency which the reflector or other parts might otherwise have of gravitating into a new position.

PROJECTILE. — A projectile for ordnance has been patented by Mr. M. Gledhill. The projectile consists of a hollow cylinder, its penetrating end having an annular surface of impact; this surface is bevelled to give it a rather sharp edge, so that in striking an armour plate in a direction normal to the surface thereof, the action will be somewhat like that of a hollow punch, and except when the angle of the axis of the projectile with the surface is very acute, the glancing of the shot from this surface will be almost impossible. The rear end of the projectile is provided with a plug or cover which forms a surface on which the pressure of the gas generated by the explosion of the powder will be exerted. This plug drops from the projectile when it leaves the gun.

CARTRIDGE.—Mr. A. H. Walker has patented a sea-oiling cartridge. The cartridge consists of a shell containing powder in the rear part of its interior, and having another shell containing oil in the forward part of its interior, the latter being provided with a forward opening. When discharged, this shell is driven through the wall of the containing shell and out to the desired distance over the sea. During its flight the open end is kept forward by the rotation of the projectile on its axis, and the oil kept in by the pressure of the air. When it reaches the end of its range the projectile sinks base downward a little below the surface of the water. The oil then escapes, rises to the surface, and spreads into a film, thus stilling the waves.

POCKET COMBINATION TOOL.—A combination tool to be carried in the pocket has been patented by Mr. W. Body. This tool comprises a corkscrew, a piercer, a button-hook, and a seal. The appliance is constructed in two parts, one fitting in the other, to be carried in the pocket. The corkscrew portion is provided with a square flat top with a hole through it. The flat surface is used as the seal. When required as a corkscrew the portion comprising the piercer and button-hook is passed through the hole, thus forming a cross-piece for convenience in turning the screw. The piercer and button-hook consists of a round portion with one end sharpened as a piercer and the other end formed into a hook. The hook and piercer portion fits into the screw portion, and is thus carried in the pocket.

GRINDING ALMONDS.—An apparatus for grinding almonds has been patented by Mr. W. T. Oschwald. It consists essentially of a hollow perforated cylinder fitting into a cone and united with same at their lower open extremities. Partitions are provided and placed in the interior of the cone in a helical direction, so as to prevent the almonds rotating with the cylinder, and to cause them to be carried downwards and through the perforations as the cylinder revolves. The cylinder is revolved by a handle which passes through a top cross-piece connecting the parts together through the centre of the cylinder, and fixed to a cross-piece at the bottom of same. When rotated the cylinder grinds the almonds placed in the cone, causing them to pass through the perforations and fall into a receptacle placed beneath for that purpose.

SALES.

The Charge for Advertisements in this Column is Sixpence for the first sixteen words, and Sixpence for every succeeding eight words. Advertisements for this Column should be received by first post on Tuesday to insure insertion in the following number.

For sale, Brotherhood 3-cylinder Engine, 6 in. by 7 in., £7. (London).—Address, S., 45, Clarendon Road, Southsea.

For sale, double Launch Engine, by Plenty, 5½ in. by 5 in. £20.—S., 45, Clarendon Road, Southsea.

Greenhouse Stoves, portable, require no chimney, no fixing, cheap, and effective.—PETERS, BARTSCH, AND CO., Derby.

A number of Microscope Objectives, Opera and Field Glasses, Thermometers, for sale cheap.—List on application to A. DANCER, 3, Monton Street, Greenheys, Manchester.

Set 50, coloured Photographic Lantern Slides of London, 6d. each, sample 9d.—5, Hanover Buildings, Southampton.

Field Glass, by Steward, Strand, nearly new, cost 90s., bargain, 35s.—HOLMES, 13, Hollis Street, Leeds.

Proctor's "Star Atlas," and "Universe of Stars," 8s. free.—R. ROWLEY, 45, Camden Street, Derby.

Astronomical Telescope, 3¼ by Wray, 4 powers, finder, tripod stand, 240s. Cost £25.—GOAMAN, Bridgeland, Bideford.

Amateur Mechanics supplied with Lathes, Drilling, Planing Machines, Castings, etc. Cash, or easy payments.—Britannia Company, 100, Houndsditch, London.

Britannia Co. *Bona-fide* makers of 300 varieties of lathes, and other engineers' tools. Prize medals. Makers to the British Government.

Wanted, by two experienced Mechanics, Model Work to do at home (Mechanical or Electrical). Specialities and ideas worked out to drawings, scale, or size. Good workmanship guaranteed. Moderate terms.—P. R., 40, Westbury Street, S.W.

Do your own Electro Plating and Gilding. System inexpensive. Particulars one stamp.—PERKS, 47, Alexandra Road, Richmond, Surrey.

Steel Name Stamps, 3d. per letter. Figures (set), 2s. 4d. Post free.—F. BALDWIN, Tuffley, Gloucester.

Meerschaum and Briar Pipes Repaired, Mounted, or Cased, ambers fitted.—W. GEORGE, 324, Essex Road, Islington, London.

Minerals, Fossils, Cretaceous, Liassic, Carboniferous, Silurian. 12 named specimens, 2s. 6d. free—CHAS. WARDINGLEY, Blackwood Crescent, Edinburgh.

EXCHANGES.

Exchange Notices will be inserted in this Column at the rate Sixpence for the first twenty-four words, and Threepence for every succeeding eight words. Advertisements for this Column should be received by first post on Tuesday to insure insertion in the following number.

Grand pair of coupled high-class model Beam Engines, bright and complete, fitted with pumps, governors, throttle valve, made regardless of cost by Lord Scarsdale's engineer, and made for work as well as show. Bargain. Half cash, half exchange.—295, St. Philip's Road, Sheffield.

New powerful Microscope, case, tongues, object-glass. Exchange for 3 in. Electric bell, new, or offers.—JOHN COLLINGE, John Street, off Cross Street, Middleton, near Manchester.

Splendid Solar Microscope, in case, by Nairne, six powers. Exchange photographic apparatus.—RIDOUT, Sunbury Common.

100 Geological Specimens, named. Exchange, 10s. Approval.—HOLDEN, Hoyland Nether, Barnsley.

I offer Lawn Mower, 52-inch Bicycle, Lockstitch Sewing Machine, or Fret-Saw and Lathe, cost £5 5s., in exchange for Lathe.—Wellesley House, Colchester.

SELECTED BOOKS.

The Frog. An Introduction to Anatomy, Histology, and Embryology. Third edition revised, with a new chapter on Development added. By A. M. Marshall. London: Smith, Elder. Price 6s.

Scientific Romances. No. 7. On the Education of the Imagination. No. 8. Many Dimensions. By C. H. Hinton. London: S. Sonnenschein. Price 1s.

Handbook of the Amaryllideæ. Including the Alstrœmerieæ and Agaveæ. By J. G. Baker, F.R.S., F.L.S., First Assistant in the Herbarium of the Royal Gardens, Kew. London: Bell and Co. Price 5s.

Electro-Plating. A Practical Handbook on the Deposition of Copper, Silver, Nickel, Gold, Aluminium, Brass, Platinum, etc., with descriptions of the Chemicals, Materials, Batteries, and Dynamo Machines used in the Art. By J. W. Urquhart, C.E. Second Edition. London: Crosby, Lockwood and Sons. Price 5s.

NOTICES.

The Title Page and Index to Vol. I., now ready, price 3d.

Binding Cases for Vol. I., price 2s. each.

Cases and Binding, Vol. I., including Title Page and Index, price 3s.

Vol. I., bound in cloth, with Title Page and Index, 9s. 6d. —by post 10s.

The Back Numbers of SCIENTIFIC NEWS can be obtained from all Booksellers and Newsagents, or direct from the Publisher, 138, Fleet-street, London, E.C. Price 3d. each, or by post 3½d.

METEOROLOGICAL RETURNS

For the ten weeks ending on Monday, August 20th, 1888. Specially prepared for SCIENTIFIC NEWS from official reports.

	Mean Temperature.	Rainfall.	Duration of Sunshine.
Scotland, East	54·2 degs., being 3·9 degs. below average.	6·5 ins., being 0·1 ins. above average.	361 hrs., being 19 hrs. below average.
England, N.E.	53·8 " " 4·5 " " "	7·9 " " 2·1 " " "	266 " " 113 " " "
England, East	57·0 " " 4·2 " " "	8·5 " " 3·1 " " "	291 " " 161 " " "
Midlands ...	56·0 " " 4·1 " " "	7·6 " " 1·5 " " "	291 " " 117 " " "
England, South	56·6 " " 3·2 " " "	8·1 " " 3·3 " " "	294 " " 158 " " "
Scotland, West	56·0 " " 1·8 " " "	8·2 " " 0·2 " " "	380 " " 5 " " "
England, N.W.	55·7 " " 3·5 " " "	9·3 " " 1·4 " " "	336 " " 48 " " "
England, S.W.	56·6 " " 3·3 " " "	9·0 " " 1·6 " " "	370 " " 95 " " "
Ireland, North	55·4 " " 2·7 " " "	9·4 " " 2·2 " " "	349 " " 43 " above "
Ireland, South	56·7 " " 2·1 " " "	8·1 " " 0·8 " " "	384 " " 25 " " "
The Kingdom...	55·8 " " 3·3 " " "	8·3 " " 1·6 " " "	332 " " 65 " below "

The above period represents the mean temperature for the Midsummer period of 1888; over the whole ten weeks, the mean loss of heat for the kingdom is shown to have been 3·3 degrees for each day. Rainfall is drawing nearer the normal, its distribution very equal; but the distribution of solar favours is becoming remarkably unequal.

Scientific News
FOR GENERAL READERS.

Vol. II. FRIDAY, SEPTEMBER 7, 1888. No. 10.

CONTENTS.

NOTICE.

We have pleasure in announcing that a Special Supplement of the Scientific News in connection with the British Association Meeting at Bath, will be published on the morning of Monday, 10th September, 1888. Arrangements have been made to give a *resumé* of each day's proceedings, as well as abstracts of papers interesting to general readers. Copies of Scientific News, as well as of the Special Supplement, can be obtained at the principal bookstalls and newsagents in Bath, or will be sent by post on sending 3½d. in stamps to the Publisher, 138, Fleet Street, London, E.C.

SCIENTIFIC TABLE TALK.

By W. Mattieu Williams, F.R.A.S., F.C.S.

In my last I referred to a visit to Agassiz, on the Aar Glacier, in 1842, which was remarkably instructive.

The nearest ordinary habitation to the glacier is the Hospice of the Grimsel, where I had already spent one day and met some of the Neufchatel glacier-students. We started for the day's excursion very jovially, all singing the "Rans des Vaches," and walked up a glaciated valley for about three-quarters of an hour, then climbed up a heap of rock fragments. This was a part of the *terminal moraine* of the glacier, the material carried by the ice in the manner presently to be described, and pitched down at the end, or foot, of the glacier.

We next mounted a tall, long ridge which appeared to be built up of similar material only. This, however, was not the case, for on removing the superficial fragments, ice was seen below. We were already on the glacier, but the ice was completely hidden. This ridge was the *medial moraine*, or *gufferlinie*, one of unusually large dimensions, especially as regards its height and width, and the magnitude of some of the blocks of stone that cover it.

But what is a gufferlinie or medial moraine ?

As the accumulated overflow of ice which constitutes a glacier travels down its valley-trough path it receives on each side, or shore, more or less of fragments which fell from the rocks immediately above.

Every such block of stone that has any considerable thickness shelters the ice on which it falls from the direct rays of the sun, and thus while the ice all round is lowered in level by the summer thawing the protected portion remains relatively higher. By such action each shore or lateral termination of the glacier becomes an elevated ridge of ice, clothed with a protective covering of rock fragments. These are the *lateral moraines*.

But it commonly happens in the upper glacial regions of the high Alps that two of these glacier valleys meet at their lower part, and spread out to fill a single still lower valley. The two glaciers thus become confluent, like rivers or their tributaries that similarly meet. It is evident that in such case the moraines of the inner shores of each glacier—*i.e.*, of those shores which meet at the confluence—must unite. They do so, and now instead of being on the shores of each of their former respective glaciers, they meet in the middle of the wider stream of ice, and thus form the medial moraine, or gufferlinie.

There are two upper branches of the Aar Glacier, the Finsteraar and the Lauteraar Glaciers—the dark and the clear glaciers. By their union they form the main lower glacier, and this medial moraine along which we walked In some places rises fully 80 feet above the general level of the naked ice, a ridge of clear ice hidden by its covering, as above described. Of its length some idea may be formed from the fact that although we walked at a good pace, we were more than three hours travelling continuously along it before we reached the great block on which was the edifice of loose stones designated, as we learned by the inscription on a big flag, the "Hôtel des Neufchatelois." This was situated a short distance below the projecting spur or promontory of rock *Im Abschwung*, at the foot of which the confluence occurs.

We were hospitably received, supplied with coffee, bread-and-cheese, and wine, and then invited to inscribe our names in the visitors' book. The leaves of this book were the facets of the great boulder on which the "hotel" was erected, and the pen and ink were a paint-brush and a pot of red ochre paint. The signatures were inscribed in characters varying from three or four inches to a foot in length.

I mention this particularly, as those names thus painted have subsequently acquired an historical scientific interest. In 1844 the block split into two pieces, and since that the frost has rent it into a mere heap of *débris*. Forty years after the first rupture—*i.e.*, in 1884—M. Forel was able to identify this heap by the vestiges of the paint-pot still remaining on some of the fragments.

It had then travelled a distance of 2,400 mètres (7,874 feet) from its position in 1840, showing that this great mass of ice on which it rested had been flowing down the valley at a mean rate of 179 feet per annum, a slower speed than usual, owing to the fact that the downward incline of this glacier is very small, so small that it appears in most parts nearly level.

This movement of glaciers is the most important element of the whole subject in reference to their work in the sculpture of the earth, and this medial moraine of the Aar Glacier is classic ground in reference to it, as it was here in the early days of glacier research that a very striking and demonstrative discovery was made. Agassiz knew that in 1827 Hugi had built a sort of refuge or shelter on the moraine, and also knew particulars concerning its position. In 1839 Agassiz, with some companions, trying to find some traces of it, spent four hours in the search, and were returning, when suddenly they came upon a solidly-built hut, but could not believe that it was Hugi's, which they knew was at the confluence of the Finsteraar and Lauteraar Glaciers, close to the Im Abschwung promontory of rock, from which they were now at a considerable distance. The hut was in good condition, even some of the hay and straw remaining on the roof. They examined the inside, and there found a bottle containing papers. One was in Hugi's handwriting, stating that he had revisited the hut in 1830, and found that it had moved about 100 paces from its original position. A second paper described a third visit in 1836, when he found that it had travelled 2,200 feet from the rock against which he built it. A third paper stated that some naturalists from Berne and Basle had at about this time repaired the hut and used it as a shelter while weather-bound in attempting to cross the glacier to Grindelwald.

Agassiz measured the distance from the original place and found that it then amounted to 4,400 feet, and therefore the hut had travelled in the three years between 1836 and 1839 as far as in the nine years from 1827 to 1836. Another measurement, in 1840, showed a progress of 200 feet in the year. These measurements he recorded in the visitors' book of the Grimsel Hospice, with an appeal to future visitors to continue the investigation.

Making due allowance for Hugi's rough measurements by stepping, a remarkable acceleration is here apparent, and is explained by subsequent observations, which show that the middle of the glacier, like the middle of a river, flows more rapidly than its sides. Hugi's hut was at first at the spot where the right and left banks of the confluent glaciers meet, but as it advanced it came out into mid-stream, and its pace was accelerated accordingly. The maximum thickness of the ice was reached at about 1836. This diminished downwards by combined action of sun-heat on the upper surface and earth-heat and friction below.

Other curious results of "ablation," or thinning down, of glaciers are peculiarly well shown on the Aar Glacier, and we examined them under expert guidance. I will describe them in my next.

ANCIENT OPINIONS AND PRE-SCIENTIFIC FANCIES CONCERNING THE INTERIOR OF THE EARTH.

MANY ages before the rise of geology, the human imagination had set itself to work, and philosophers, basing upon some notions more or less vague gleaned here and there, or setting out with the observation of a few local phenomena, had forged systems more bold and ingenious than probable or logical, with the object of explaining the structure of the earth's core. Subsequently these old paradoxes were forgotten in proportion as more serious hypotheses cropped up. Still in the year 1678 savants were far from being agreed on this mysterious question, and the margin left for dreamers was still ample.

Aristoteles proved, or believed that he had proved by means of a syllogism, which has remained famous as a specimen of a vicious circle, that the centre of the earth coincided with the centre of the visible universe. Indeed if we adopt the old astronomical notions, it would be difficult to admit that the pivot of the heavens was placed eccentrically with reference to the celestial sphere. Almost all imaginable suppositions were put forward in antiquity and in modern times when it was required to conceive the physical condition of the earth's interior. The bowels of the earth, according to Pythagoras, Empedocles, and Plato, are on fire.

Their opinion, maintained afterwards with more authority by Descartes and Leibnitz, still prevails in France, strenuously advocated by such eminent champions as Daubrée, Faye, and De Lapparent. On the contrary, according to Anaxagoras and Democritus, followed long afterwards by Woodward, we walk upon a sphere filled with water, encased in a thin coating of earth, like the shell of an egg. Buffon avowed his ignorance, but he did not favour the central fire. We do not know who first gave us a nucleus of iron. Could he return to the earth he might perceive with satisfaction that his view, far from being forgotten is still sustained, among others, by Professor Nordenskiöld. Even the very existence of terrestrial magnetism constitutes a strong argument. A certain number of more mystical thinkers supposed beneath our feet a vast void in which there circulated a sun, a moon, and planets, inhabited by plants, animals, and rational beings of a very special nature. Others affirmed that the world is perforated by a long tunnel, opening at the two poles. Less daring speculators were content to imagine the existence of great internal seas, communicating with the superficial oceans.

A very minute description of the earth's interior is given by the celebrated Father Athanasius Kircher in a work in two folio volumes, entitled *Mundus Subterraneus.* The treatise of this learned Jesuit merits the name of an encyclopædia, for we find here condensed the principles or the applications of all the sciences which are closely or remotely connected with the main question: geography, astronomy, mechanics, physics, chemistry, and natural history.

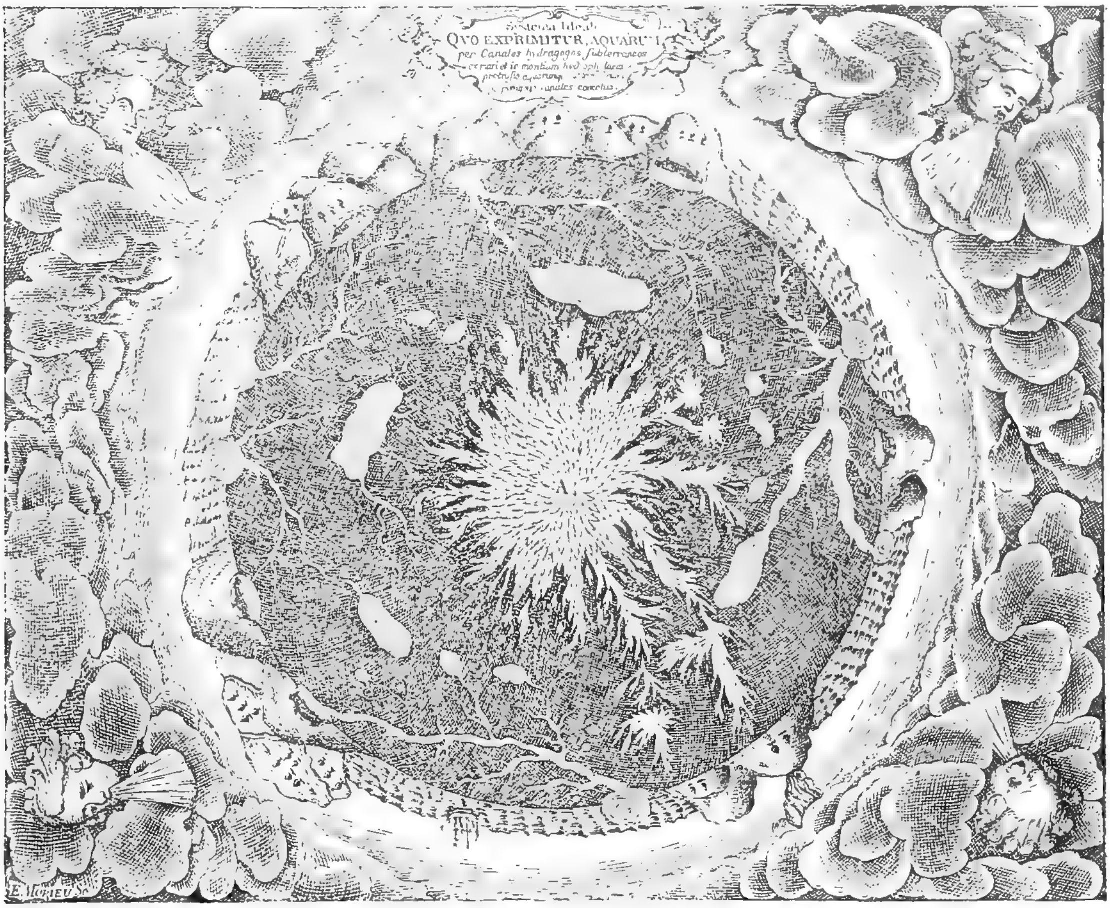
The subjoined figure which we borrow from *La Nature* is taken from an engraving in Kircher's great work, published in 1678. It is an ideal section of the earth, showing the central fire, A, and the internal circulation of the waters.

Kircher's fundamental idea is a parallelism between the human body or *microcosm* and the earth, *geocosm.*

The inmost nucleus of the latter is in a state of ignition, but the constitution of the mean and higher strata is most heterogeneous. To our intestines, there correspond subterranean canals and abysses of water (*hydrophylacia*), which feed the springs, and through them communicate with all the seas. A central fire radiates through innumerable veins (*pyrophylacia*), which vivify and warm the globe, feeding the volcanoes and heating the hot springs. In our body, the vital spirits (*sanguis spirituosus*) acts in a similar manner. How is the globe to respire without the *aërophylacia*, vast hollow reservoirs corresponding to the lungs and filled with air? The air of the *aërophylacia* escapes through branching conduits, and serves firstly to maintain the combustion of the igneous masses which would otherwise be extinguished; but besides, a certain number of pipes vent into superficial caverns, thus occasioning the winds. We must not forget that the baseless matter here propounded is mixed with sound, accurate nations which our modern geologists do not reject. Father Kircher was not merely a traveller and a compiler; he had travelled and observed, and had made many experiments.

An analogy between the heavenly bodies and men or animals is still accepted by certain speculators. In a work published six years ago, and bearing the modest title, "The Perfect Way," we are told that the planets are persons, and even possess memory. Father Kircher makes a much more frugal use of his imagination.

We must never forget that our positive acquaintance with the earth's interior amounts to nothing. We have not penetrated to the depth of five miles, which is as if we had explored a body 133 feet in thickness to the depth of one inch! Surely such knowledge is too literally superficial.



IDEAL SECTION OF THE EARTH (AFTER KIRCHER).

ON THE GEOLOGY OF BATH AND THE NEIGHBOURHOOD.

(*Continued from p.* 198.)

WE now pass to the Secondary or Mezozoic rocks, which rest on the upturned edges of the Palæozoic strata, or, as it should be more properly expressed, rest unconformably. The explanation of this is that at the close of the Carboniferous Period some of the strata which had formed was raised above sea-level, and became land. When this was accomplished, the land was subjected to denudation, and by this process other rocks were originated.

The sub-systems of the Mesozoic Period, with which this article is concerned, are the Permian, Trias, and Jurassic. The Permians form a debatable ground between the Carboniferous and Trias, but into the merits of the arguments we need not enter.

The Trias formation as typically developed on the Continent of Europe, consists of the following divisions:—

3. Keuper.
2. Muschelkalk.
1. Bunter.

In England the Muschelkalk has not been clearly proved to be represented, but we have the equivalents of the Bunter and Keuper. The Bunter series are not developed in the neighbourhood of Bath, but there are some beds which may correspond with the Keuper, and these are of considerable interest. They are locally known as the Dolomite or Magnesian Conglomerate, so-called from dolomite (carbonate of lime and magnesia) forming a cementing matrix, by which the boulders and pebbles which occur in the rock are held together. The Dolomitic Conglomerate may be seen to advantage at Clifton, on the left-hand side of the "New Road" leading from Clifton to the Hot Wells.*

Among the varied life of the Trias Period reptiles were very abundant, which, indeed, is a feature of the secondary strata, and hence it has sometimes been called the "Age of Reptiles."

The only inference that can be drawn from the blocks of Carboniferous limestone constituting the Conglomerate is, that the limestone must have undergone denudation. The Dolomitic Conglomerate is probably a consolidated beach; if we compare its appearance with what we see on the beaches around our coasts and islands, the similarity is at once apparent. Sir H. De la Beche says, in reference to the origin of the conglomerate, "Standing on any high ground or the Mendip Hills, it is interesting to consider how exactly the masses occur as they should do, under the supposition that they have been beaches among islands, raised above the sea of the times."

The Trias period is also represented by the New Red Marl, which, however, is not of much interest. The various localities at which it is exposed may be readily seen by reference to the Geological Survey map of the district around Bath. The Trias period was brought to a close by the formation of a series of beds, known on the Continent as the Rhœtic. The equivalent strata in this country are typically represented at Penarth near Cardiff, and they are therefore sometimes known as the Penarth Beds. In England they occupy the position of passage beds between the Trias and Lias formations.

At the base of the Rhœtic beds in this country we get a series of green and red marls, which represent the last of the Trias rocks. Then a well-marked physical change is indicated by a very interesting bed, in which the shell *Avicula contorta* is numerous, and this suggested to Dr. Wright that it should be called the *Avicula contorta* bed. Then follow black shales in one of which, the "Bone Bed," fish and reptilian remains are especially abundant. Then another change is indicated by a cream-coloured limestone, named by William Smith, in 1815, the White Lias. Now, the *Avicula contorta* zone and the White Lias are well-defined geological landmarks, and hence Mr. Charles Moore* has included in the Rhœtic series the strata between those two horizons.

Near the base of the White Lias is a well-known ornamental limestone, known as the "Landscape Marble," which is about one foot thick. One of the best exposures of the White Lias is to be seen just outside Bath, near the Weston station on the Midland Railway.

We now enter upon the Jurassic rock, on which Bath rests, and of which the hills surrounding the city are built up. The Jurassic period of the earth's history is typically represented in the Jura Mountains, and hence the name Jurassic. In this country there are two distinctive series, namely, the Lias and Oolitic. It is the former of these which overlie the White Lias of the Rhœtic, and are clearly distinguished by the blue colour of the limestone, and dark intervening shales. According to Sir H. De la Beche, the term Lias originated with the Somersetshire quarrymen, and by them was applied to distinguish argillaceous limestone forming a part of the succession of strata now all included under the name. Of the reptiles which inhabited the Lias seas, estuaries, rivers, and land we have some most wonderful combinations of structure. Three groups are found—the *Enaliosaurians*, or marine reptiles, the *Pterodactylians*, or aerial reptiles, and the *Teleosaurians*, or river and land reptiles.

The most prominent group are the *Enaliosaurs*, or Sea-Lizards, the two groups of which are represented respectively by the *Ichthyosaurus* and *Plesiosaurus*. Good specimens may be seen in the Bath Museum, and some of the best ever obtained have been found in the Lower Lias of Street in Somersetshire. The *Ichthyosaurus* was indeed a wonderful creature. In size it was sometimes as much as 24 feet in length; it had the skull of a crocodile, the eye fashioned like a bird and a turtle. It had the backbone of a fish, the paddle of a whale, and the scapular arch of a *Platypus*.

The *Plesiosaurus* was hardly less remarkable. It was distinguished by its long neck, resembling that of a swan united to the trunk of a quadruped, with ribs like a chameleon.

There is another reptile that appears for the first time in the Lias, which has a unique history, seeing that nothing approaching to it is found either in living or extinct natural forms. This is the *Pterodactyle*, a flying reptile, whose skeleton was modified and adapted to an aerial life. It had some resemblance to bats and birds, but was widely different from both. In bats the whole anterior extremity is elongated to form a framework of a wing, but in the *Pterodactyle* it was only the little finger that was lengthened and strengthened to become a rod for supporting a membrane, whilst the other parts of the hand, the thumb, and three inner fingers retain their normal size. Like birds, the long bones of the arm were hollow cylinders, and it differed from birds in having the skull of Reptilia. Its jaws were armed with long teeth implanted in distinct sockets.

The Teleosaurians, or land reptiles, appear in the Upper Lias. Several examples of small specimens have been found in the fish-bed of Dumbledon, and in the same formation in Somersetshire as well as in Yorkshire.

English geologists divide the Lias, as represented in this country, into three divisions, namely, Lower, Upper, and Middle, and each one is marked by palæontological

* The Dolomite Conglomerate is also well shown at Tytherington.

* "Quart. Jour. Geol. Soc.," vol. xvii., p. 495, 1861.

and lithological differences. These divisions are further distinguished by zones of life—that is to say, that at certain periods during the progress of this formation certain creatures lived more abundantly than at others, or lived only during the time that certain strata were forming, and then disappeared. Many of these forms of life remain as fossils, and hence it is that we are enabled to make out certain horizons or zones which characterise the Lias. In marking these zones the Ammonites are the chief indicators. Thus the Lower Lias is marked by seven Ammonite zones, the Middle Lias by five, and the Upper by three.

Before referring further to the life of the Jurassic period it may be well to say something more respecting the rocks. The Upper Lias beds pass up into yellow sandy strata, which are typically represented at Midford, near Bath, and were therefore at first named the Midford Sands. Above the sands we get a very interesting bed, called by Dr. Wright the *Cephalopoda* bed, because of the number of Ammonites and Belemnites which occur in it; and it is here that some geologists draw the line between the lias and succeeding oolitic formations.

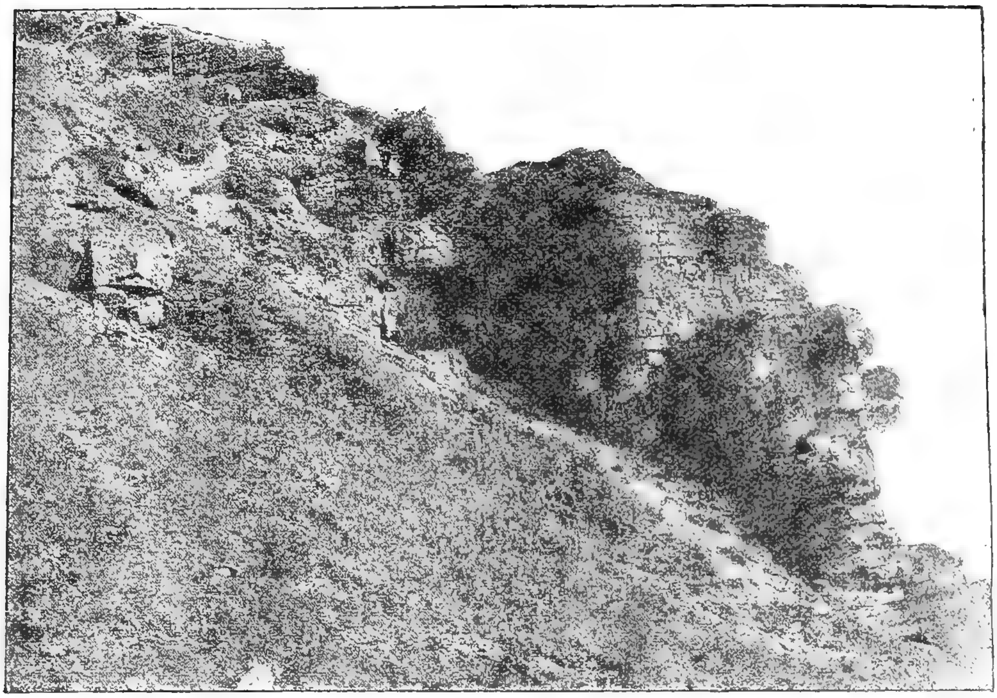


FIG. 5.—THE PEA GRIT AS EXPOSED AT CLEEVE HILL, NEAR CHELTENHAM.

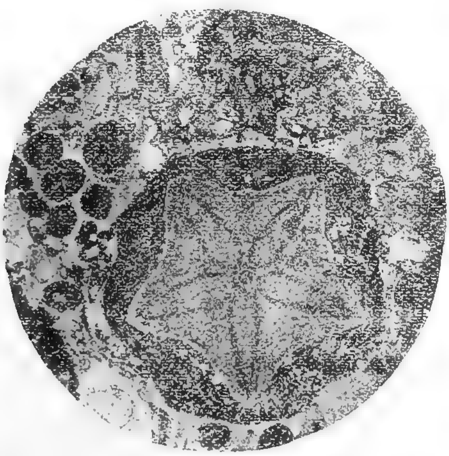


FIG. 6.—MICRO-PHOTOGRAPH OF A SECTION OF THE PEA GRIT, FROM CLEEVE HILL, NEAR CHELTENHAM. (Enlarged.)

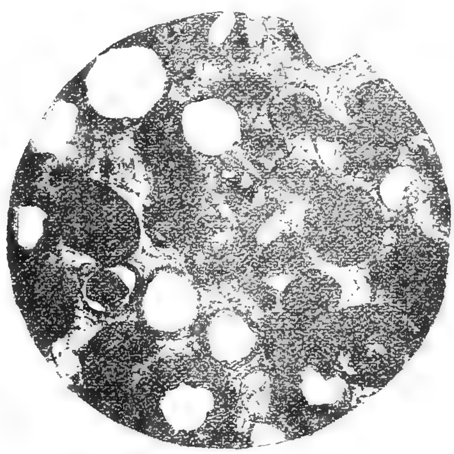


FIG. 7.—MICRO-PHOTOGRAPH OF A SECTION OF BATH STONE (GREAT OOLITE.) (× 22 diams.)

The term Oolite is from the Greek *oon*, an egg, and *lithos*, a stone. The name is suggested from the structure of a large portion of the rock, which is made up of minute granules resembling somewhat the roe of an egg. The Oolitic formation is divided as follows :—

Upper Oolitic	Purbeck Beds.
	Portland Beds.
	Kimeridge Clays.
Middle Oolitic	Coralline Beds.
	Oxford Clay and Kelloway Rock.
Lower Oolitic	Great Oolite Series.
	Inferior Oolite.

The inferior Oolite is extensively developed in the Cotswold Hills, especially near Cheltenham, where it is about 236 ft. thick, but thins out in the direction of Bath, where it is represented by about 25 ft. Near the base of the inferior Oolite at Cheltenham a remarkable series of beds known as the Pea Grit occur (fig. 5.) The name appears to be suggested from the resemblance of the granules to peas, which they do in size and shape. Fig. 6 is a micro-photograph of a section of this rock from Cleeve Hill, near Cheltenham, and illustrates the structure and mode of formation of Oolitic strata. The rock is seen to be made up of oval and round granules, the largest of them measuring a little over one-eighth of an inch in diameter, and the smallest ·014. In each of the granules there is a nucleus around which layers of carbonate of lime have formed. This is best seen in the large type of granule, which is known as Pisolite, to distinguish it from the smaller or Oolitic grains. In the case of the Pisolite granule in fig. 6 the nucleus is that of a joint of a Pentacrinite, and is shown in section. These crinoids were allied to the Encrinites to which we referred when describing the Carboniferous Limestone, but in the case of the Pentacrinus the joints are five-sided. These creatures were numerous in the Jurassic Sea, and have contributed to the strata in the same way, though less extensively, that the Encrinites did to the Carboniferous Limestone. The smaller granules in the Oolite have a variety of objects, as nuclei; sometimes a portion of a spine of an Echinus, a fragment of shell, a foraminifera or grain of sand.

Fig. 8.—Micro-Photograph of a Section of Forest Marble. (× 22 diams.)

The Inferior Oolite terminates at the horizon of the Fuller's Earth, a material well known for its use in commerce. The maximum thickness of the formation is about 400 ft., which includes clays, marls, and nodules of earthy limestone. At Bath, however, it is not more than 150 ft., and continues to decrease in thickness until on reaching the Valley of the Windrush it dies out, so that in the country round Burford the inferior Oolite and great Oolite series are in contact.

The great Oolite series are thus divided by Mr. H. B. Woodward, in his "Geology of England and Wales :—

3. Cornbrash.
2. Forest Marble and Bradford Clay.
1. Great Oolite { Upper zone. / Lower zone, Stonesfield slate.

The name Stonesfield Slate was taken from the village of Stonesfield. The formation appears to be that of an estuarine deposit, for among the fossils which it contains are those of plants, consisting of Algæ, Ferns, and Conifers. The conditions under which the Stonesfield Slate formed extended over an extensive area in East Gloucestershire, but is not represented around Bath nearer than at Stroud. Some of the beds yield slabs which are worked for roofing purposes, and hence the term slate, as applied to this rock.

Above the Stonesfield Slate comes the Bath or Great Oolite, which is extensively quarried on the hills around Bath and mined at Box. Visitors to Bath should endeavour to visit one of these mines, for they will see a sight which they will never forget. At Bath the Great Oolite is 150 feet thick, and consists of limestone made up of shell *débris*, tough calcareous rocks mixed with clay and fine oolitic limestones, the latter being the typical "Bath Stone."

Of the Bath Stone it is very difficult to get a thin section suitable for examination under a microscope, owing to the oolitic granules being so loosely held together. Directly we begin to grind down a piece of the rock the granules fall out. Fig. 7 is a photograph of a section in which a number of granules remain, but they are not thin enough to show the nuclei. In the figure the spaces between the granules are seen to be filled with infilling calcite, which affords a good example of the process by which limestone has become compact. The white oval spaces have been made by the falling out of granules.

At the close of the Great Oolite period there followed conditions which were not favourable to the formation of limestones, and a deposit of clay took place known as the Bradford Clay, the name being taken from Bradford, in Wiltshire, where the clay is best developed.

Then there was another change of conditions, and limestone-forming organisms again appeared, and their calcareous remains collecting on the sea floor gave rise to a shelly limestone known as the forest marble. Fig. 8 is a micro-photograph of this rock, which shows it to be chiefly made up of fragments of shells and some oolitic granules; but in the photograph the places occupied by the granules are represented by circular holes, the granules having dropped out during the grinding down of the section.

On the other members of the Jurassic system we must not enter, but the mode of formation and structure differs little from those already referred to.

The life of the Oolitic period resembled that of the Lias, but we find some fresh genera and species. Corals were numerous; in the inferior Oolite of the Cotswold Hills there are three fossil coral reefs. Oolitic limestone is at the present day formed in the coral seas, and it is therefore possible, even likely, that the carbonate of lime which formed around the nuclei of oolitic granules may have been derived from that source. Visitors to the Bath Stone quarries should have no difficulty in obtaining good specimens of the coral *Halamophyllia radiata*, which is most numerous in the upper beds.

[We regret that by an unfortunate mistake figures 2 and 3 on page 197 were transposed.]

General Notes.

STRANDED WHALES.—A large whale, which had stranded on the east coast near Snettisham, was last week towed to Hunstanton. It is about 30 ft. long. A smaller whale was also stranded at Heacham, near Hunstanton.

THE DEEPEST WELL IN THE WORLD.—A well of the depth of 3,000 to 6,000 yards is to be sunk in the United States if Congress can be prevailed upon to vote the necessary funds. The results of this enterprise, if carried out, will doubtless prove exceedingly instructive.

NATIVE GOLD IN LIMESTONE.—At a meeting of the Philadelphia Academy of Natural Sciences, Professor Leidy exhibited a fragment of metamorphic limestone from Eldorado county, California, having on its surface a spot of native gold—the first instance he had seen of gold occurring in limestone.

DISCOVERY OF MINERALS IN RUSSIA.—The Russian *Journal of Metallurgical Industries* states that large deposits of silver and lead have just been discovered in the upper part of the Kouban and on the banks of its affluents, the Douot and Outchkolan. Some oil springs have also been found in the same quarter.

DISTINCTIONS BETWEEN COLOURS.—We may have colours which if illuminated by daylight or gaslight seem perfectly identical, but if illuminated by a monochromatic light, such as that of sodium, will appear different, unless the chemical composition of the colouring matters is absolutely identical. In this manner cheques and other documents which have been fraudulently altered may sometimes be detected.

SHIP-CANAL ACROSS ITALY.—A canal is projected intersecting Italy from west to east. It will begin near Castro, on the Tuscan coast, and terminate at Fano, in the Adriatic. The length will be 283 kilomètres, its mean width 100 yards, and its depth 12 yards. It will be used to effect the desiccation of the lakes of Bolsena and Thrasimenæ. The expense is estimated at 500 million francs.

DETERIORATION OF HANDWRITING.—The *Journal of the Franklin Institute*, noticing a circular issued by the French Geographical Society calling an "International Geographical Congress" for 1889, remarks that of all the signatures to this document "but one is clearly legible, and two are absolutely illegible. It seems as if all over the world the legibility of handwriting is decreasing. There are few of the smooth and unmistakable handwritings of a century ago." A parallel fact is the deterioration of style, especially to be noted in English writers.

PHOTOGRAPHS OF LIGHTNING.—M. Ch. Mousette, in a communication to the Paris Academy of Sciences, suggests that the peculiarities observed in the photographs of lightning may be principally due to vibrations imparted to the apparatus by tremors of the soil, by the wind, or by the rolling of the thunder. In support of this view, he executed in black on white a design consisting of points and lines variously inclined, and has then photographed it, firstly keeping the camera free from all vibrations, and secondly exposing it to slight shocks. In the second case the proofs present the form of a striated band.

NEW APPLIANCE FOR FISHING BY THE ELECTRIC LIGHT.—A paragraph in *Cosmos* states that experiments have been made on board the steamer *President Herweg* in the North Sea to test a new apparatus for submarine electric lighting, devised by an engineer of the name of Pellenz. The results have been very satisfactory; the lamp acted without accident at the bottom of the sea, the depth being 100 fathoms, giving a light of 100 candles, whilst the vessel was steaming at the rate of four miles per hour. The fishes, attracted by the light, floated to the apparatus. This is said to have been the first experiment of the kind made in the open sea.

MORTALITY DUE TO LEAD.—According to *Cosmos*, Dr. Carter, of the Board of Health at Baltimore, advances the opinion that the use of drinking-water holding lead in solution is a predisposing cause of scarlatina and diphtheria. During the fifty-four years from 1830 to 1883 the average annual mortality from scarlet fever in that city has been 225, and in the last year of the term 334. On January 1st, 1884, a new law concerning plumbing work came into force, and the deaths have since been—1884, 104; 1885, 68; 1886, 32; and 1887, 36; or a yearly mean of 60. The mean yearly death-rate from diphtheria prior to 1884 was 469, but since that date it has sunk to 234.

THE MINING INSTITUTE OF SCOTLAND.—This institute held its annual summer meeting at Dalkeith, on the 23rd ult. The first part of the programme consisted of a visit to Newbattle and Arniston Collieries. The members were received at Newbattle Colliery by Mr. Morison, when an examination was made of the works above ground and under ground, the same programme being carried out as at the visit of the Iron and Steel Institute. Afterwards they proceeded to Arniston Collieries, where they were received by Mr. Clark, and, after seeing the works there, left by special train for Dalkeith. In the afternoon a general meeting was held, and the election of new members took place. Mr. James Hastie was elected to the office of vice-president, and Mr. Wallace Thorneycroft to the office of councillor.

THE ADULTERATION OF SHERRY.—In the last issue of the United States Consular Reports the Consuls at Cadiz and Jerez de la Frontera return to the subject of the adulteration of sherry, on which they recently reported most unfavourably. Mr. Ingraham, of Cadiz, sends a translation of a circular from the Spanish Minister of the Interior to the civil governors of the provinces, directing prosecutions against the makers and vendors of adulterated wines, in accordance with a Royal decree against adulteration. Adulterated wines are thus defined in the decree—(1) Natural wines which contain impure industrial alcohol and alcohol from husks (*cascara*), if they are not rectified and purified; (2) salicylic acid and other antiseptic substances; (3) foreign coloured substances, those derived from the products of pit coal (*sic*), as well as of vegetable or other origin; (4) artificial glucose, sugar from flour, or new wine; (5) glycerine.

BOOKS AS TRANSMITTERS OF INFECTION.—According to the *Lancet*, the municipal authorities of Dresden have instituted an experimental inquiry into the probability of the transmission of zymotic disease by the medium of library-books. A number of volumes from the town library which had been in frequent use were taken for experiment. The dust from the leaves and covers was sown in nutrient solutions, and cultivations were reared. But there appeared no disease germs, the dust being of a non-organised character. Next some of the dirtiest leaves were rubbed first with a dry, and then with a wet finger. On the dry finger scarcely any microbia were found; on the wet finger there were many, but all of a non-infectious character. In particular the bacilli of tubercle were absent. The conclusion drawn was that the danger of infection through books from circulating libraries is very slight, but it is recommended to dust such volumes well before reading, and never to wet the finger in the mouth in order to turn over the leaves.

An "In Memoriam" Tablet to Charles Darwin, at Edinburgh.—A report was published in a recent issue of this paper, stating that it was the intention of some people to put up an "In memoriam" tablet at 11, Lothian Street, Edinburgh, where Charles Darwin resided with his brother during some part, or mayhap the whole of the session 1825-6. This is certainly a praiseworthy object, but it should be pointed out that it would probably have been accomplished nearly three months ago by another set of people than those at present interested, had they not been directly asked by Mr. Francis Darwin, the son of the late Charles Darwin, not to proceed in the matter until further investigations had been made; the reason of postponement being to allow Mr. Darwin to find out whether his father had remained any length of time at Lothian Street or had removed elsewhere, and until this point had been settled those formerly interested in the matter determined to do nothing. It may therefore be as well to wait until Mr. Francis Darwin has settled this point, as he is likely soon to do, having lately heard of some early letters of his father which may throw light on the Edinburgh life.

Lead-poisoning by Home-made Wines.—The *Sanitary Record* has drawn attention to the danger of lead-poisoning by wines made in the ordinary glazed earthenware pans, such glaze containing sometimes 50 or 60 per cent. of red or white lead. In his last report on the Alcester rural sanitary district, Dr. Fosbroke, the medical officer of health, records some cases that came under his notice. Members of two families residing at Inkberrow were attacked by unmistakable symptoms of lead-poisoning. On inquiring Dr. Fosbroke ascertained that the persons affected had partaken of some home-made wine, though not by any means in large quantities. This wine, he learnt, was made from black currants and plums, which in the course of preparation were allowed to ferment in a glazed earthenware washing pan. This pan showed signs of corrosion, and there seems no doubt that the lead which is used in the "glaze" had been taken up by the wine and imbibed by the sufferers. As the manufacture of home-made wine is more common among the labouring classes than it used to be, it should be borne in mind that the fermentative process required for its manufacture should be carried out in wooden vessels, and the ordinary glazed earthenware pans be specially avoided.

A Destroyed Island.—Dr. Treub, the director of the Botanical Garden at Buitenzorg, Java, has published his experience with regard to the reappearance of vegetation upon the Island of Kraketoa, which partly sank, and was wholly overwhelmed by the ashes and pumice-stone from its volcano during the violent outbreak of 1883. Three years after this day, Dr. Treub (on 26th June, 1886) visited the island, and as he approached it he found that it was covered with vegetation to the very summit of the mountain. The plants could not have grown from the roots or seeds of those existing before the great eruption, for the toughest organism must have been destroyed by the excessive volcanic heat. The whole island was covered with a layer of ashes and pumice-stone from 3 ft. to 240 ft. thick. Nor could the vegetation, Dr. Treub thinks, have been introduced by man, for the island is uninhabited and difficult of access. It must have been by means of seeds carried thither by birds, the wind, or the currents of the sea that the new vegetation arose. It consists for the most part of ferns, of which eleven different varieties were found, and of single specimens of blossoming herbs, such as are found on coral reefs that have lately risen above the level of the sea. Dr. Treub has, however, found that the ferns were not the first living plants that had found nourishment on the destroyed island. Almost everywhere there were signs that the ashes and pumice-stone had been covered by a thin layer of algæ, which rendered the surface of the soil soft and capable of absorbing water. These microscopic algæ prepared the way for the ferns, and the latter, in their turn, for the blossoming herbs.—*Daily News*.

The Public Health.—The Registrar-General's return for the week ending August 25th shows that the deaths registered during that period in 28 great towns of England and Wales corresponded to an annual rate of 18·1 per 1,000 of their aggregate population, which is estimated at 9,398,273 persons in the middle of this year. The five healthiest places were Bristol, Brighton, Derby, Sunderland, and Birmingham. In London 2,401 births and 1,438 deaths were registered. Allowance made for increase of population, the births were 300 and the deaths 115 below the average numbers in the corresponding weeks of the last ten years. The annual death-rate per 1,000 from all causes, which had been 15·9, 18·0, and 16·2 in the three preceding weeks, rose again last week to 17·5. During the first eight weeks of the current quarter the death-rate averaged 16·2 per 1,000, and was 4·7 below the mean rate in the corresponding periods of the ten years 1878-87. The 1,438 deaths included 47 from measles, 21 from scarlet fever, 17 from diphtheria, 28 from whooping-cough, 7 from enteric fever, 192 from diarrhœa and dysentery, 7 from cholera and choleraic diarrhœa, and not one from small-pox, typhus, or ill-defined forms of continued fever; thus, 319 deaths were referred to these diseases, being 36 below the corrected average weekly number. In Greater London 3,167 births and 1,821 deaths were registered, corresponding to annual rates of 29·9 and 17·2 per 1,000 of the population. In the outer ring 58 deaths from diarrhœa, 13 from measles, and 8 from diphtheria were registered. The fatal cases of diarrhœa included 15 in Tottenham, 9 in West Ham, and 6 in Enfield sub-districts. Three deaths from measles were returned in Croydon, in Willesden, and in Tottenham sub-districts; and the fatal cases of diphtheria included 2 in Edmonton and 2 in Walthamstow sub-districts.

Natural History.

THE GORGONA ANTELOPE.

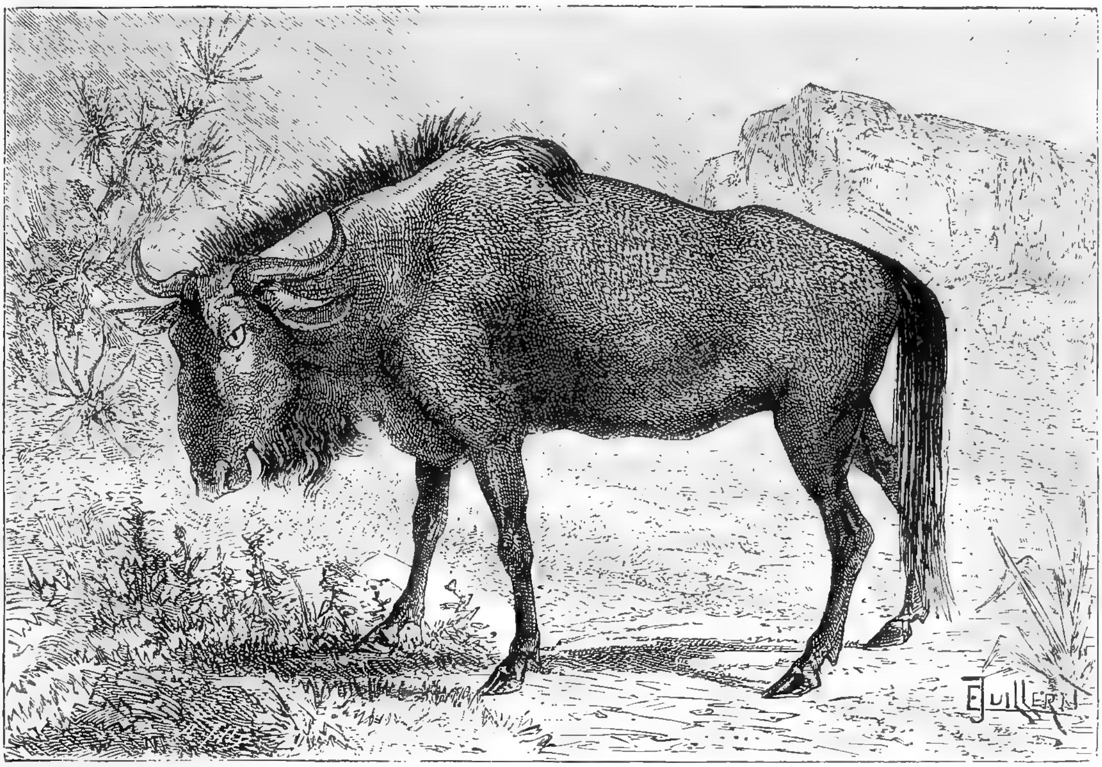
AMONG the numerous and varied family of the antelopes, there is one group differing widely in appearance from the rest, and presenting at first sight almost the characters of a monstrosity. This group belongs to the southern part of the African continent, and includes the common and the brindled gnu (*Catoblepas gnu* and *Catoblepas gorgon*), or gorgona, which we are about to describe. Both these species have a head and neck like those of a bull, joined to the hind-quarters and the tail of a horse. All the species of *Catoblepas*, though natives of a hot climate, are able to live in Europe in the open air, and to multiply in captivity. The horns of the gnu are expanded at the base, so as to form a kind of shield at the top of the head. This shield does not exist in the gorgona, or blue wildebeest as it is called by the European settlers in South Africa. Its horns, though very thick at the root, remain separate, turning outwards and curving upwards only at the extremity.

The physiognomy of the animal, like that of the gnu, is sinister, and its temper is exceedingly uncertain. Indeed, it must be remarked that all the larger antelopes, like the deer, are very unsafe as pets. Contrary to the common belief, they are much less to be trusted when domesticated than are carnivorous animals. The gorgona has not a trace of the tuft of black hair which grows along the middle of the nose of the gnu. As in the latter species, however, the chin is ornamented with a beard which falls back upon the throat. The upper side of the neck supports a stiff, bristly mane, extending backwards to the withers.

The skin of the gorgona differs in colour from that of the gnu. It is of an iron-grey, passing to reddish on the lower parts of the body, and it appears marked on the neck and on the flanks by perpendicular stripes. But these stripes, which are by no means very distinct, are not produced as in the zebra and the tiger by differences of colour; they are due merely to the arrangement of the hair, which diverges, and the tips of which meet in lines which are very regular. The mane and the beard are strongly shaded with black, as well as the tail, which reaches down to the ground.

According to Dr. Kirk, the well-known explorer, the gorgona antelope is called *kokong* by the Bechuanas, and *nyumbo* by the Manganjas and the tribes inhabiting the banks of the Zambeze. It is, or rather was, very common in all this region of South Africa, especially in Batokoland and on the borders of Lake Shirwa. Here it associates in numerous bands with the zebras, ostriches, and giraffes. The natives hunt it very eagerly, not for its flesh, which is tough and of an unpleasant taste, but for its tail. This appendage passes among these savages as a wonderful talisman, capable of ensuring success in their warlike expeditions.

In the month of November the old males separate from their herds and wander through the country, always ready to pick a quarrel with any other males which they may meet. If alarmed, they generally make one or two wide circuits before taking to flight. Our figure is taken from *La Nature*.



THE GORGONA ANTELOPE.

Speed of Carrier Pigeons.—According to *La Nature*, four pigeons belonging to Count Karolyi, flew, in 1884, from Paris to Buda-Pesth in seven hours. Their speed must, therefore, have been nearly 185 kilometres per hour, or nearly 115 miles.

Formation of Vegetable Mould.—According to *La Nature*, Dr. M. C. Keller, of the University of Zurich, has recently published his researches on this subject, conducted in Madagascar. He fully confirms the results of Darwin. In Madagascar an earth-worm more than a yard in length (*Geophagus Darwini*) plays the principal part in the formation of soil.

Localisation of the Cerebral Centre of Visual Perception.—Mr. Alexandre Vitzon, in a communication laid before the Academy of Sciences, concludes that, in dogs at least, the integrity of sight is connected with the integrity of the occipital lobes of the brain, the destruction of this part of the brain occasioning immediate, complete and permanent blindness in both eyes.

A Train Stopped by Locusts.—*Cosmos* figures and describes a recent scene of this kind in Algeria. The crushed insects formed an oily paste upon the rails, so that the wheels turned round without advancing. An account has reached us of a train in Australia being obliged, in order to force its way through a marching column of caterpillars, to go back for upwards of a mile, and then return at the highest possible speed.

Ravages of Ferocious Animals in India.—According to the *Quarterly Review*, the number of human beings killed by wild beasts in 1886 was 2,707: by wild elephants, 57; by tigers, 928; by leopards, 194; by bears, 113; by wolves, 222; by hyaenas, 24; by other animals (doubtless chiefly death-snakes), 1,169. The number of wild animals destroyed was, elephants, 7; tigers, 1,464; leopards, 4,051; bears, 1,668; wolves, 6,725; hyaenas, 1,650; other animals, 6,852.

CORRESPONDENCE.

The Editor does not hold himself responsible for opinions expressed by his correspondents, nor can he take notice of anonymous communications. All letters must be accompanied by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

EXPANSION OF INDIA-RUBBER.

In the very interesting paper on "Mechanical Refrigeration" (in Scientific News, August 3rd, p. 100) there is a statement which, left unexplained, might lead the general reader into a misunderstanding of the properties of india-rubber. To the correct remark, "Most substances expand when they are heated, and contract when they are cooled; and, conversely, when they are compressed their temperature rises, and it falls when they are allowed to expand," the author appends this doubtful note:—"India-rubber is an exception. If an elastic band be suddenly extended while it is touching the lips, it will feel warm, and when it is relaxed it will feel colder." Now, in the extension of the elastic band, there is no expansion, and in the relaxation there is no compression. There is merely a change of form. The cubic contents of the material are the same in all the cases. If you compress cork, heat is generated; in this case the compression diminishes the cubic contents of the cork. It is quite different with india-rubber. This can be tested practically. If a cylindrical metal tube be completely filled with a piece of india-rubber, and both ends be tightly closed; if pressure be applied to make the cylinder change its shape and become elliptical in section instead of circular, what is the result? It is well known that with the circular section the cylinder's contents are a maximum; and any change of form would therefore diminish the contents. But with the india-rubber the pressure does not alter the shape of the cyclinder; strike it with a hammer, and the effect is, as it were, on a piece of solid iron. Pressure does not, then, compress india-rubber, it only produces a change of form. It is different with cork. Fit cork into the circular cylinder and close the ends. Put on a pressure, and the form of the cylinder is easily changed, because the cork is compressible, with the additional exceptional property of elasticity which enables it to recover its shape when the pressure is removed.

J. G. M.

A COBRA'S REVENGE.

In your issue of the 24th ult. was a cutting sent by G. G., bearing this title, so thinking the subject of some interest, I send you the enclosed cuttings from the *Madras Mail*:—

"Sir,—Under the above heading there appeared in your issue of 7th inst. an account of the death of engine-driver A. Fischer, at Pennar, an employé in the Madras Railway Co's service. The author of the account must have drawn deeply on his imagination to concoct so tragic a tale out of the meagre facts at his disposal. About 5 a.m. on the 3rd inst., while asleep in his quarters, Mr. Fischer was bitten on the hand, by a rat as he supposed at the time. At 6 a.m. he went to work, but feeling unwell, obtained leave from duty at 7.30, and reported himself to the apothecary. The symptoms, as described to me, might have been caused by a cobra's bite, and in spite of treatment, he rapidly got worse, and died at 2.45 p.m. No one had seen a cobra in the compound for a month previous to the occurrence, but a snake was killed in a tree in Fischer's compound the day after his death, and shown to me on the 5th inst. It was not a cobra. There is no evidence to prove that driver Fischer died from the effects of snake-bite, and it is to be regretted that an autopsy was not held upon the body. Unfortunately, I did not appear upon the scene until after the funeral.—*H. Leslie Ansted* (*Medical Officer, Madras Railway Co.*)."

"Sir,—The account in the *Madras Mail* of the 7th inst. of the death of Mr. Andrew Fischer, of the Madras Railway Co., at the Pennar Bridge Works, from cobra-bite, with the remarks of 'Kellayan,' reminds me of a story which I have heard repeated oftener than once by Major George Proudfoot, late military secretary to H.H. the Nizam. When he lived at Bowen Pillay, part of the cantonment of Secunderabad, where the native cavalry regiment is quartered, he saw, one evening as he went in his gate, a cobra hastening across the large grassy compound towards a hedge. He gave it chase, and seeing that he would not be able to overtake it before it reached the hedge, he flung at it the heavy walking-stick he carried in his hand, but missed it. Immediately the cobra turned round, and when the Major made off in the direction of his house it pursued him. The affair might have had a tragic ending for him if his syces had not observed it from the stables, and come to his rescue with bamboos, torn from the stables' verandah, with which they despatched the cobra. On the theory of the superior wisdom of the serpent, one wonders why the cobra, when it knew that its pursuer had parted with his weapon of offence, did not carry out its original intention and quietly take refuge in its hole in the hedge. On the theory of the revengeful nature of the cobra, as stated by 'Kellayan,' the action of this particular member of the species in following after its pursuer with deadly intent is explained.—*J.*"

M. H. L.

STRANGE ACTION OF A BEETLE.

Referring to the curious behaviour of a beetle (Scientific News, Aug. 17th), it occurs to me that the insect may have been injured in *one* eye, and that, seeing only with the other, it may have thought it was progressing in a straight line, when in reality it was describing a circle.

Althorne, West Bournemouth. C. Carus-Wilson.

The British Association.

BATH, SEPT. 5.

THE 58th annual meeting of the British Association opened to-day with the usual meeting of the council at 1 o'clock, under the presidency of Sir Henry Roscoe. The meeting of the general committee was held at the Guildhall under the presidency of Sir Henry Roscoe.

The minutes of the Manchester meeting having been read by Mr. Atchison,

Sir Douglas Galton read the report of the council, which notified the election of a large number of corresponding members and the nomination of Archdeacon Browne as a vice-president of the meeting. The report further stated that invitations for the year 1890 would be presented from Leeds and Cardiff, and from Edinburgh for the year 1891, and continued,

"The council have received the following report from a committee of the council appointed to consider the question of grants to marine biological stations in this country, together with a letter from Professor E. Ray Lankester, secretary of the Marine Biological Association, suggesting that the British Association should complete its donations to the funds of that association so as to make up the sum given to the amount of £500, thereby securing certain rights:

"The British Association has up to the present time granted altogether £300 to the Marine Biological Association, and by a further grant of £200 the British Association would be entitled to nominate a representative on the council of the Marine Biological Association. The committee are of opinion that the council should recommend the general committee to grant the £200, and appoint a member to represent them on the council of the Marine Biological Association.

"With reference to the grants to marine biological stations generally, the committee are of opinion that in all these cases it is desirable that grants in future should be made to individuals for specific researches rather than for the general maintenance of institutions; and with reference to the Scottish stations they would further call the attention of the council to the fact that the Scotch Fishery Board has a Parliamentary grant of £2,000 per annum for scientific investigations, the whole of which, it appears from the appropriation accounts, is not at present expended."

The council, having received the above report, have forwarded it, together with the letter of Professor Ray Lankester, to the committee of Section D.

In accordance with the regulations, the five retiring members of the council will be Professor W. Boyd Dawkins, F.R.S., Professor J. Dewer, F.R.S., Professor W. H. Flower, C.B., Dr. J. H. Gladstone, and Professor H. N. Moseley. The council recommend the re-election of the other ordinary members of council, with the addition of the following gentlemen:—Dr. Gamgee, Dr. A. Geikie, Professor Liveing, Mr. W. H. Preece, and Professor Rucker.

On the motion of the President the report was adopted. Dr. Williamson read the financial statement, which showed a total income for the year of £8,441. The grants made amounted to £1,511. The balance at the bank was £239. The investment account showed a total of £12,839 10s. 5d. The accounts were adopted. Mr. Atchinson presented a list of officers of sections, and the recommendations committee having been appointed, the meeting adjourned till Monday.

In the evening Professor Sir Henry Roscoe, the retiring president, took the chair in the large drill-hall, and was cordially received. He addressed the assembly as follows:—

My Lords, Ladies, and Gentlemen,—Four-and-twenty eventful years in the history of science have passed away since the British Association last visited the city of Bath. Those of us who were present here in 1864 will not soon forget that memorable meeting. It was presided over, as you all will remember, by that veteran geologist, that great forerunner of a new science of life, Sir Charles Lyell, of beloved and venerated memory. Yes, ladies and gentlemen, it was he who prepared the way by his recognition of the true history of our globe for the even more illustrious Darwin. It was he who pointed out that the causes which have modified the earth's crust in the past are for the most part those which are now changing the face of nature. Lyell was a typical example of the expositor of nature's most secret processes. His work was that of an investigator of science pure and undefiled, and as such his life and labours stand for ever as an example to all those who love science for her own sake. But the far-seeing founders of this our British Association were as fully alive to the fact as we, in perhaps our more utilitarian age, can be that, just as man does not live by bread alone, so it is not only by purely scientific discovery that the nations progress or that science advances. They knew as well as we do that to benefit humanity the application of the results of scientific research to the great problems of everyday life is a necessity. Hence our founders, while acknowledging that the basis of our Association can only be securely laid upon the principles of pure science in its various branches, recognised the importance of the application of those principles in the establishment of a section which should represent one of the most remarkable outcomes of the activity and force of the nation—a section of engineering. It is therefore meet and right that, in due proportion, this great department of our scientific edifice, a department which, perhaps, more than any other, has effected a revolution in our modern social systems, should be represented in our presidential chair. Twenty-four years ago it was pure science that we honoured in Sir Charles Lyell: to-day it is applied science to which we show our respect in the person of Sir Frederick Bramwell. It would ill become me, engaged as I have been in the study of subjects far removed from those which fill the life of an active and successful engineer, to venture on this occasion on a eulogium upon the work of my successor; still less is it in my mind to draw any comparison as to the relative importance to be attached to the work of the investigator such as Lyell, and to that of him who applies the researches of others to the immediate wants of mankind. It is enough for me, as I am sure it will be for you, to remember that both classes of men are needed for the due advancement of science, and to rejoice that as in former years the names of Fairbairn, of Armstrong, and of Hawkshaw have adorned our list of Presidents, so in the present instance this branch of science, which represents lines of human activity rendered illustrious by the labours of many great Englishmen, is to-day represented by our eminent President. I have the honour of requesting Sir Frederick Bramwell to take the chair, and to favour us with the Presidential address.

ADDRESS BY SIR FREDERICK BRAMWELL, D.C.L., F.R.S., M.INST.C.E., PRESIDENT.

THE late Lord Iddesleigh delighted an audience, for a whole evening, by an address on "Nothing." Would that I had his talents, and could discourse to you as charmingly as he did to his audience, but I dare not try to talk about "Nothing." I do, however, propose, as one of the two sections of my address, to discourse to you on the importance of the "Next-to-nothing." The other section is far removed from this microscopic quantity, as it will embrace the Eulogy of the Civil Engineer, and will point out the value to science of his works.

I do not intend to follow any system in dealing with these two sections. I shall not even do as Mr. Dick, in "David Copperfield," did—have two papers, to one of which it was suggested he should confine his memorial and his observations as to King Charles's head. The result is, you will find, that the importance of the next-to-nothing and the laudation of the Civil Engineer will be mixed up in the most illogical and haphazard way, throughout my Address. I will leave to such of you as are of orderly minds the task of rearranging the subjects as you see fit, but I trust—arrangement or no arrangement—that by the time I have brought my address to a conclusion I shall have convinced you that there is no man who more thoroughly appreciates the high importance of the "next-to-nothing" than the Civil Engineer of the present day, the object of my eulogy this evening.

If I may be allowed to express the scheme of this Address in modern musical language, I will say that the "next-to-nothing" "motive" will commonly usher in the "praise-song" of the Civil Engineer, and it seems to me will do this very fitly, for in many cases it is by the patient and discriminating attention paid to the effect of the "next-to-nothing" that the Civil Engineer of the present day has achieved some of the labours of which I now wish to speak to you.

An Association for the Advancement of Science is necessarily one of such broad scope in its objects, and is so thoroughly catholic as regards science, that the only possible way in which it can carry out those objects at all, is to segregate its members into various subsidiary bodies, or sections, engaged on particular branches of Science. Even when this division is resorted to, it is a hardy thing to say that every conceivable scientific subject can be dealt with by the eight Sections of the British Association. Nevertheless, as we know, for fifty-seven years the Association has carried on its labours under Sections, and has earned the right to say that it has done good service to all branches of Science.

Composed, as the Association is, of a union of separate Sections, it is only right and according to the fitness of things that, as time goes on, your Presidents should be selected, in some sort of rotation, from the various Sections. This year it was felt, by the Council and the Members, that the time had once more arrived when Section G—the Mechanical Section—might put forward its claim to be represented in the Presidency; the last time on which a purely engineering Member filled the chair having been at Bristol in 1875, when that position was occupied by Sir John Hawkshaw. It is true that at Southampton, in 1882, our lamented friend Sir William Siemens was President, and it is also true that he was a most thorough engineer and representative of Section G; but all who knew his great scientific attainments will probably agree that, on that occasion, it was rather the Physical Section A which was represented, than the Mechanical Section G.

I am aware it is said Section G does not contribute much to pure Science by original research, but that it devotes itself more to the application of Science. There may be some foundation for this assertion, but I cannot refrain from the observation, that when Engineers, such as Siemens, Rankine, Sir William Thomson, Fairbairn, or Armstrong make a scientific discovery, Section A says it is made, not in the capacity of an Engineer, and, therefore, does not appertain to Section G, but in the capacity of a Physicist, and therefore appertains to Section A—an illustration of the danger of a man's filling two positions, of which the composite Prince-Bishop is the well-known type. But I am not careful to labour this point, or even to dispute that Section G does not do much for *original* research. I don't agree it is a fact, but for the purposes of this evening I will concede it to be so. But what then? This Association is for the "Advancement of Science"—the *Advancement*, be it remembered; and I wish to point out to you, and I trust I shall succeed in establishing, that for the *Advancement* of Science it is absolutely necessary there should be the *Application* of Science, and that, therefore, the Section, which as much as any other (or, to state the fact more truly, which more than any other) in the Association *applies* Science is doing a very large share of the work of *advancing* Science, and is fully entitled to be periodically represented in the Presidency of the whole Association.

I trust also I shall prove to you that applications of Science and discoveries in pure Science act and react the one upon the other. I hope in this to carry the bulk of my audience with me, although there are some, I know, whose feelings, from a false notion of respect for Science, would probably find vent in the "toast" which one has heard in another place—this "toast" being attributed to the Pure Scientist—"Here's to the latest scientific discovery: may it never do any good to anybody!"

To give an early illustration of this action and reaction, which I contend occurs: take the well-worn story of Galileo, Torricelli, and the pump-maker. It is recorded that Galileo first, and his pupil Torricelli afterwards, were led to investigate the question of atmospheric pressure, by observing the failure of a pump to raise water by "suction" above a certain level. Perhaps you will say the pump-maker was not applying science, but was working without science. I answer, he was unknowingly applying it, and it was from that which arose in this unconscious application that the mind of the Pure Scientist was led to investigate the subject, and thereupon to discover the primary fact, of the pressure of the atmosphere, and the subsidiary facts which attend thereon. It may appear to many of you that the question of the exercise of pressure by the atmosphere should have been so very obvious, but little merit ought to have accrued to the discoverer; and that the statement, once made, must have been accepted almost as a mere truism. This was, however, by no means the case. Sir Kenelm Digby, in his "Treatise on the Nature of Bodies," printed in 1658, disputes the proposition altogether, and says, in effect, he is quite sure, the failure of the pump to raise water was due to imperfect workmanship of some kind or description, and had nothing to do with the pressure of the air, and that there is no reason why a pump should not suck up water to any height. He cites the boy's sucker, which, when applied to a smooth stone will lift it, and he says the reason why the stone follows the sucker is this: Each body must have some other body in contact with it. Now, the stone being in contact with the sucker, there is no reason why that contact should be broken up for the mere purpose of substituting the contact of another body, such as the air. It seems pretty clear, therefore, that even to an acute and well-trained mind, such as that of Sir Kenelm Digby, it was by no means a truism, and to be forthwith accepted when once stated, that the rise of water on the "suction side" of a pump was due to atmospheric pressure. I hardly need point out that the pump-maker should have been a member of "G." Galileo and Torricelli, led to reflect by what they saw, should have been members of "A" of the then "Association for the Advancement of Science."

But passing away from the question of the value of the application of science of a date some two and a half centuries ago, let us come a little nearer to our own times.

Electricity—known in its simplest form to the Greeks by the results arising from the friction on amber, and named therefrom; afterwards produced from glass cylinder machines, or from plate machines; and produced a century ago by the "Influence" machine—remained, as did the discoveries of Volta and Galvani, the pursuit of but a few, and even the brilliant experiments of Davy did not suffice to give very great impetus to this branch of physical science.

Ronalds, in 1823, constructed an electric telegraph. In 1837 the first commercial use was made of the telegraph, and from that time electrical science received an impulse such as it had never before experienced. Further scientific facts were discovered; fresh applications were made of these discoveries. These fresh applications led to renewed vigour in research, and there were the action and reaction of which I have spoken. In the year 1871 the Society of Telegraph Engineers was established. In the year 1861 our own Association had appointed a Committee to settle the question of electrical standards of resistance, which Committee, with enlarged functions, continued its labours for twenty years, and of this Committee I had the honour of being a member. The results of the labours of that Committee endure (somewhat modified, it is true), and may be pointed to as one of the evidences of the value of the work done by the British Association. Since Ronald's time, how vast are the advances which have been made in electrical communication of intelligence, by land lines, by submarine cables all over the world, and by the telephone! Few will be prepared to deny the statement that pure electrical science has received an enormous impulse, and has been advanced by the commercial application of electricity to the foregoing, and to purposes of lighting. Since this latter application, scores, I may say hundreds, of acute minds have been devoted to electrical science, stimulated thereto by the possibilities and probabilities of this application.

In this country, no doubt, still more would have been done if the lighting of districts from a central source of electricity had not been, since 1882, practically forbidden by the Act passed in that year. This Act had in its title the facetious statement that it was "to facilitate Electrical Lighting," although it is an Act which, even modified as it has been this year, is still a great discouragement of free enterprise, and a bar to progress. The other day a member of the House of Commons was saying to me, "I think it is very much to our discredit in England that we should have allowed ourselves to be outrun in the distribution of electric lighting to houses, by the inhabitants of the United States, and by those of other countries." Looking upon him as being one of the authors of the "facetious" Act, I thought it pertinent to quote the case of the French parricide, who, being asked what he has to say in mitigation of punishment, pleads, "Pity a poor orphan"—the parricide and the legislator being both of them authors of conditions of things which they affect to deplore. I will say no more on this subject, for I feel that it would not be right to take advantage of my position here to-night to urge Political Economy views, which should be reserved for Section F. I will merely, and as illustrative of my views of the value of the application of Science to Science itself, say there is no branch of physics pursued with more zeal and with more happy results than that of electricity, with its allies, and there is no branch of Science towards which the public looks with greater hope of practical benefits; a hope that, I doubt not, will be strengthened after we have had the advantage of hearing one of the ablest followers of that science, Professor Ayrton, who, on Friday next, has been good enough to promise to discourse on "The Electrical Transmission of Power."

One of the subjects which, as much as (or probably more than) any other, occupies the attention of the engineer, and therefore of Section G, is that of (the so-called) Prime Movers, and I will say boldly that, since the introduction of printing by the use of movable type, nothing has done so much for civilisation as the development of these machines. Let us consider these prime movers—and, first, in the comparatively humble function of replacing that labour which might be performed by the muscular exertion of human beings, a function which at one time was looked upon by many kindly but short-sighted men as taking the bread out of the mouth of the labourer (as it was called), and as being therefore undesirable. I remember revisiting my old schoolmaster, and his saying to me, shaking his head:—"So you have gone the way I always feared you would, and are making things of iron and brass, to do the work of men's hands."

It must be agreed that all honest and useful labour is honourable, but when that labour can be carried out without the exercise of any intelligence, one cannot help feeling that the result is likely to be intellectually lowering. Thus it is a sorry thing to see unintelligent labour, even although that labour be useful. It is but one remove from unintelligent labour which is not useful; that kind of labour generally appointed (by means of the tread-wheel or the crank) as a punishment for crime. Consider even the honourable labour (for it is useful, and it is honest) of the man who earns his livelihood by turning the handle of a crane, and compare this with the labour of a smith, who, while probably developing more energy by the use of his muscles, than is developed by the man turning the crane-handle, exercises at the same time the powers of judgment, of eye, and of hand in a manner which I never see without my admiration being excited. I say that the introduction of prime movers as a mere substitute for unintelligent manual labour is in itself a great aid to civilisation and to the raising of humanity, by rendering it very difficult, if not impossible, for a human being to obtain a livelihood by unintelligent work—the work of the horse in the mill, or of the turnspit.

But there are prime movers and prime movers—those of small dimensions, and employed for purposes where animal power or human power might be substituted, and those which attain ends that by no conceivable possibility could be attained at all by the exertion of muscular power.

Compare a galley—a vessel propelled by oars—with the modern Atlantic liner; and first let us assume that prime movers are non-existent and that this vessel is to be propelled galley-fashion. Take her length as some 600 feet, and assume that place be found for as many as 400 oars on each side, each oar worked by three men, or 2,400 men; and allow that six men under these conditions could develop work equal to one horse-power: we should have 400 horse-power. Double the number of men, and we should have 800 horse-power, with 4,800 men at work, and at least the same number in reserve, if the journey is to be carried on continuously. Contrast the puny result thus obtained with the 19,500 horse-power given forth by a large prime mover of the present day, such a power requiring, on the above mode of calculation, 117,000 men at work and 117,000 in reserve; and these to be carried in a vessel less than 600 feet in length. Even if it were possible to carry this number of men in such a vessel, by no conceivable means could their power be utilised so as to impart to it a speed of twenty knots an hour.

This illustrates how a prime mover may not only be a mere substitute for muscular work, but may afford the means of attaining an end, that could not by any possibility be attained by muscular exertion, no matter what money was expended or what galley-slave suffering was inflicted.

Take again, the case of a railway locomotive. From 400 to 600 horse-power developed in an implement which, even including its tender, does not occupy an area of more than 50 square yards, and that draws us at sixty miles an hour. Here again, the prime mover succeeds in doing that which no expenditure of money or of life could enable us to obtain from muscular effort.

To what, and to whom, are these meritorious prime movers due? I answer: to the application of science, and to the labours of the Civil Engineer, using that term in its full and proper sense, as embracing all engineering other than military. I am, as you know, a Civil Engineer, and I desire to laud my profession and to magnify mine office; and I know of no better means of doing this than by quoting to you the definition of "civil engineering" given in the Charter of the Institution of Civil Engineers, namely, that it is "the art of directing the great sources of power in Nature for the use and convenience of man." These words are taken from a definition or description of engineering given by one of our earliest scientific writers on the subject, Thomas Tredgold, who commences that description by the words above quoted, and who, having given various illustrations of the civil engineer's pursuits, introduces this pregnant sentence:—

"This is, however, only a brief sketch of the objects of civil engineering, the real extent to which it may be applied is limited only by the progress of science; its scope and utility will be increased with every discovery in philosophy, and its resources with every invention in mechanical or chemical art, since its bounds are unlimited, and equally so must be the researches of its professors."

"The art of directing the great sources of power in Nature for the use and convenience of man." Among all secular pursuits, can there be imagined one more vast in its scope, more beneficent, and therefore more honourable, than this? There are those, I know—hundreds, thousands—who say that such pursuits are not to be named as on a par with those of literature; that there is nothing ennobling in them; nothing elevating; that they are of the earth, earthy; are mechanical, and are unintellectual, and that even the mere bookworm, who, content with storing his own mind, neither distributes those stores to others nor himself originates, is more worthily occupied than is the civil engineer.

I deny this altogether, and, while acknowledging, with gratitude, that, in literature, the masterpieces of master minds have afforded, and will afford, instruction, delight, and solace for all generations, so long as civilisation endures, I say that the pursuits of civil engineering are worthy of occupying the highest intelligence, and that they are elevating and ennobling in their character.

Remember the kindly words of Sir Thomas Browne, who said, when condemning the uncharitable conduct of the mere bookworm, "I make not, therefore, my head a grave, but a treasure of knowledge, and study not for mine own sake only, but for those who study not for themselves." The engineer of the present day finds that he must not make his "head a grave," but that, if he wishes to succeed, he must have, and must exercise scientific knowledge; and he realises daily the truth that those who are to come after him must be trained in science, so that they may readily appreciate the full value of each scientific discovery as it is made. Thus the application of science by the engineer not only stimulates those who pursue science, but adds him to their number.

Holding, as I have said I do, the view that he who displaces unintelligent labour is doing good to mankind, I claim for the unknown engineer who, in Pontus, established the first water-wheel of which we have a record, and for the equally unknown engineer who first made use of wind for a motor, the title of pioneers in the raising of the dignity of labour, by compelling the change from the non-intelligent to the intelligent.

With respect to these motors—wind and water—we have two proverbs which discredit them—"Fickle as the wind," "Unstable as water."

Something more trustworthy was needed—something that we were sure of having under our hands at all times. As a result, Science was applied, and the "fire" engine, as it was first called, the "steam" engine, as it was renamed, a form of "heat" engine, as we now know it to be, was invented.

Think of the early days of the steam-engine—the pre-Watt days. The days of Papin, Savory, Newcomen, Smeaton! Great effects were produced, no doubt, as compared with no fire-engine at all; effects so very marked as to extort from the French writer, Belidor, the tribute of admiration he paid to the "fire" engine erected at the Fresnes Colliery by English engineers. A similar engine worked the pumps in York-place (now the Adelphi) for the supply of water to portions of London. We have in his work one of the very clearest accounts, illustrated by the best engravings (absolute working drawings), of the engine which had excited his admiration. These drawings show the open-topped cylinder, with condensation taking place below the piston, but with the valves worked automatically.

It need hardly be said that, noteworthy as such a machine was, as compared with animal power, or with wind or water motors, it was of necessity a most wasteful instrument as regards fuel. It is difficult to conceive in these days how, for years, it could have been endured that at each stroke of the engine the chamber that was to receive the steam at the next stroke was carefully cooled down beforehand by a water injection.

Watt, as we know, was the first to perceive, or, at all events, to cure, this fundamental error which existed prior to his time in the "fire" engine. To him we owe condensation in a separate vessel, the doing away with the open-topped cylinder, and the making the engine double-acting; the parallel motion; the governor; and the engine indicator, by which we have depicted for us the way in which the work is being performed within the cylinder. To Watt, also, we owe that great source of economic working—the knowledge of the expansive force of steam; and to his prescience we owe the steam jacket, without which expansion, beyond certain limits, is practically worthless. I have said "prescience"—foreknowledge—but I feel inclined to say that, in this case, prescience may be rendered "pre-Science," for I think that Watt *felt* the utility of the steam jacket, without being able to say on what ground that utility was based.

I have already spoken in laudatory terms of Tredgold, as being one of the earliest of our scientific engineering writers, but, as regards the question of steam jacketing, Watt's prescience was better than Tredgold's science, for the latter condemns the steam jacket, as being a means whereby the cooling surfaces are enlarged, and whereby, therefore, the condensation is increased.

I think it is not too much to say, that engineers who, since Watt's days, have produced machines of such marvellous power—and, compared with the engines of Watt's days, of so great economy—have, so far as principles are concerned, gone upon those laid down by Watt. Details of the most necessary character—necessary to enable those principles to be carried out—have, indeed, been devised since the days of Watt. Although it is still a very sad confession to have to make, that the very best of our steam-engines only utilises about one-sixth of the work which resides (if the term may be used) in the fuel that is consumed, it is, nevertheless, a satisfaction to know that great economical progress has been made, and that the 6 or 7 lbs. of fuel per horse-power per hour consumed by the very best engines of Watt's days, when working with the aid of condensation, is now brought down to about one-fourth of this consumption; and this in portable engines, for agricultural purposes, working without condensation—engines of small size, developing only 20 horse-power; in such engines the consumption has been reduced to as little as 1·85 lb. per brake horse-power per hour, equal to 1·65 lb. per indicated horse-power per hour, as was shown by the trials at the Royal Agricultural Society's meeting at Newcastle last year—trials in which I had the pleasure of participating.

In these trials, Mr. William Anderson, one of the Vice-Presidents of Section G, and I were associated, and, in making our report of the results, we adopted the balance-sheet system, which I suggested and used so long ago as 1873 (see vol. 52, pages 154 and 155, of the "Minutes of Proceedings of the Institution of Civil Engineers"), and to which I alluded in my address as President of G at Montreal.

I have told you that the engineer of the present day appreciates the value of the "next-to-nothings." There is an old housekeeping proverb that if you take care of the farthings and the pence, the shillings and the pounds will take care of themselves. Without the balance-sheet one knows that for the combustion of 1 lb. of coal, the turning into steam of a given quantity of water at a given pressure is obtained. It is seen, at once, that the result is much below that which should be had, but to account for the deficiency is the difficulty. The balance-sheet, dealing with the most minute sources of loss—the farthings and the pence of economic working—brings you face to face with these, and you find that improvement must be sought in paying attention to the "next-to-nothings."

Just one illustration. The balance-sheet will enable you at a glance to answer this, among many important questions. Has the fuel been properly burnt?—with neither too much air, nor too little.

At the Newcastle trials our knowledge as to whether we had the right amount of air for perfect combustion was got by an analysis of the waste gases, taken continuously throughout the whole number of hours' run of each engine, affording, therefore, a fair average. The analysis of any required portion of gases thus obtained was made in a quarter of an hour's time by the aid of the admirable apparatus invented by Mr. Stead, and, on the occasion to which I refer, manipulated by him. In one instance an excess of air had been supplied, causing a percentage of loss of 6·34. In the instance of another engine there was a deficiency of air, resulting in the production of carbonic oxide, involving a loss of 4 per cent. The various percentages of loss, of which each one seems somewhat unimportant, in the aggregate amounted to 28 per cent., and this with one of the best boilers. This is an admirable instance of the need of attention to apparently small things.

I have already said that we now know the steam-engine is really a heat-engine. At the York meeting of our Association I ventured to predict that, unless some substantive improvement were made in the steam-engine (of which improvement, as yet, we have no notion), I believed its days, for small powers, were numbered, and that those who attended the centenary of the British Association in 1931 would see the present steam-engines in museums, treated as things to be respected, and of antiquarian interest to the engineers of those days, such as are the open-topped steam cylinders of Newcomen and of Smeaton to ourselves. I must say I see no reason, after the seven years which have elapsed since the York meeting, to regret having made that prophecy or to desire to withdraw it.

The working of heat-engines, without the intervention of the vapour of water, by the combustion of the gases arising from coal, or from coal and from water, is now not merely an established fact, but a recognised and undoubted, commercially economical, means of obtaining motive power. Such engines, developing from 1 to 40 horse power, and worked by the ordinary gas supplied by the gas mains, are in most extensive use in printing works, hotels, clubs, theatres, and even in large private houses, for the working of dynamos to supply electric light. Such engines are also in use in factories, being sometimes driven by the gas obtained from "culm" and steam, and are giving forth a horse power for, it is stated, as small a consumption as one pound of fuel per hour.

It is hardly necessary to remind you—but let me do it—that, although the saving of half a pound of fuel per horse power appears to be insignificant, when stated in that bald way, one realises that it is of the highest importance when that half-pound turns out to be 33 per cent. of the whole previous consumption of one of those economical engines to which I have referred.

The gas-engine is no new thing. As long ago as 1807, a M. de Rivaz proposed its use for driving a carriage on ordinary roads. For anything I know he may not have been the first proposer. It need hardly be said that in those days he had not illuminating gas to resort to, and he proposed to employ hydrogen. A few years later, a writer in *Nicholson's Journal*, in an article on "flying machines," having given the correct statement that all that is needed to make a successful machine of this description is to find a sufficiently light motor, suggests that the direction in which this may be sought is the employment of illuminating gas, to operate by its explosion on the piston of an engine. The idea of the gas-engine was revived, and formed the subject of a patent by Barnett in the year 1838. It is true this gentleman did not know very much about the subject, and that he suggested many things which, if carried out, would have resulted in the production of an engine which could not have worked; but he had an alternative proposition which would have worked.

Again, in the year 1861, the matter was revived by Lenoir, and in the year 1865, by Hugon, both French inventors. Their engines obtained some considerable amount of success and notoriety, and many of them were made and used; but in the majority of cases they were discarded as wasteful and uncertain. The Institution of Civil Engineers, for example, erected a Lenoir in the year 1868, to work the ventilating fan, but after a short time they were compelled to abandon it, and to substitute a hydraulic engine.

At the present time, as I have said, gas-engines are a great commercial success, and they have become so by the attention given to small things, in popular estimation—to important things, in fact, with which, however, I must not trouble you. Messrs. Crossley Brothers, who have done so much to make the gas-engine the commercial success that it is, inform me that they are prosecuting improvements in the direction of attention to detail, from which they are obtaining greatly improved results.

But, looking at the wonderful petroleum industry, and at the multifarious products which are obtained from the crude material, is it too much to say, that there is a future for motor engines, worked by the vapour of some of the more highly volatile of these products—true vapour—not a gas, but a condensable body, capable of being worked over and over again? Numbers of such engines, some of as much as 4 horse power, made by Mr. Yarrow, are now running, and are apparently giving good results; certainly excellent results as regards the compactness and lightness of the machinery; for boat purposes they possess the great advantage of being rapidly under way. I have seen one go to work within two minutes of the striking of the match to light the burner.

Again, as we know, the vapour of this material has been used as a gas in gas-engines, the motive power having been obtained by direct combustion.

Having regard to these considerations, was I wrong in predicting that the heat-engine of the future will probably be one independent of the vapour of water? And, further, in these days of electrical advancement, is it too much to hope for the direct production of electricity from the combustion of fuel?

As the world has become familiar with prime movers, the desire for their employment has increased. Many a householder could find useful occupation for a prime mover of $\frac{1}{4}$ or $\frac{1}{2}$ horse power, working one or two hours a day; but the economical establishment of a steam-engine is not possible until houses of very large dimensions are reached, where space exists for the engine, and where, having regard to the amount of work to be done, the incidental expenses can be borne. Where this cannot be, either the prime mover, with the advantages of its use, must be given up as a thing to be wished for, but not to be procured, or recourse must be had to some other contrivance—say to the laying on of power, in some form or another, from a central source.

I have already incidentally touched upon one mode of doing this, namely, the employment of illuminating gas, as the working agent in the gas-engine; but there are various other modes, possessing their respective merits and demerits—all ingenious, all involving science in their application, and all more or less in practical use—such as the laying-on of special high-pressure water, as is now being extensively practised in London, in Hull, and elsewhere. Water at 700 lbs. pressure per inch is a most convenient mode of laying on a large amount of power, through comparatively small pipes. Like electricity, where, when a high electro-motive force is used, a large amount of energy may be sent through a small conductor, so with water, under high pressure, the mains may be kept of reasonable diameters, without rendering them too small to transmit the power required through them.

Power is also transmitted by means of compressed air, an agent which, on the score of its ability to ventilate, and of its cleanliness, has much to recommend it. On the other hand, it is an agent which, having regard to the probability of the deposition of moisture in the form of "snow," requires to be worked with judgment.

Again, there is an alternative mode for the conveyance of power by the exhaustion of air, a mode which has been in practical use for over sixty years.

We have also the curious system pursued at Schaffhausen, where quick-running ropes are driven by turbines, these being worked by the current of the river Rhine; and at New York, and in other cities of the United States, steam is laid on under the streets, so as to enable domestic steam-engines to be worked, without the necessity of a boiler, a stoker, or a chimney, the steam affording also means of heating the house when needed.

Lastly, there is the system of transmitting power by electricity, to which I have already adverted. I was glad to learn, only the other day, that there was every hope of this power being applied to the working of an important subterranean tramway.

These distributions from central sources need, as a rule, statutory powers to enable the pipes or wires to be placed under the roads; and, following the deplorable example of the Electrical Facilities Act, it is now the habit of the enlightened corporation and the enterprising town clerk of most boroughs to say to capitalists who are willing to embark their capital in the plant for the distribution of power from a central source—for their own profit, no doubt, but also, no doubt, for the good of the community—"We will oppose you in Parliament, unless you will consent that, at the end of twenty-one years, we may acquire compulsorily your property, and may do so, it it turns out to be remunerative, without other payment than that for the mere buildings and plant at that time existing." This is the way English enterprise is met, and then English engineers are taunted, by Englishmen—often by the very men who have had a share in making this "boa-constrictor" of a "Facilities Act"—that their energy is not to be compared with that which is to found in the United States and other countries. Again, however, I must remember that I am not addressing Section F.

There is one application of science, by engineers, which is of extreme beauty and interest, and that cannot be regarded with indifference by the agriculturalists of this country. I allude to the Heat-withdrawing Engines (I should like to say "cold-producers," but I presume, if I did, I should be criticised), which are now so very extensively used for the importation of fresh meat, and for its storage when received here. It need hardly be said that that which will keep cool and sweet the carcases of sheep will equally well preserve milk, and many other perishable articles of food. We have in these machines daily instances that, if you wish to make a ship's hold cold you can do it by burning a certain quantity of coals—a paradox, if ever there was one.

In this climate of ours, where the summer has been said to consist of "three hot days and a thunderstorm," there is hardly need to make a provision for cooling our houses, although there is an undoubted need for making a provision to heat them. Nevertheless, these of us who have hot-water heating arrangements for use in the winter would be very glad indeed if, without much trouble or expense, they could turn these about, so as to utilise them for cooling their houses in summer. Mr. Loftus Perkins, so well known for his labours in the use of very high-pressure steam (600 to 1,000 lbs. on the inch), and also so well known for those most useful high-pressure warming arrangements which, without disfiguring our houses by the passage of large pipes, keep them in a state of warmth and comfort throughout the winter, has lately taken up the mode of—I will say it—producing "cold" by the evaporation of ammonia, and, by improvements in detail, has succeeded in making an apparatus which, without engine or pumps, produces "cold" for some hours in succession, and requires, to put it in action, the preliminary combustion of only a few pounds of coke or a few feet of gas.

As I have said, our climate gives us but little need to provide or employ apparatus to cool our houses, but one can well imagine that the Anglo-Indian will be glad to give up his punkah for some more certain, and less draughty, mode of cooling.

I now desire to point out how, as the work of the engineer grows, his needs increase. New material, or better material of the old kind, has to be found to enable him to carry out these works of greater magnitude. At the beginning of this century, stone, brick, and timber were practically the only materials employed for that which I may call standing engineering work—*i.e.*, buildings, bridges, aqueducts, and so on—while timber, cast iron, and wrought iron were for many years the only available materials for the framing and principal parts of moving machines and engines, with the occasional use of lead for the pipes and of copper for pipes and for boilers.

As regards the cast iron, little was known of the science involved (or that ought to be involved) in its manufacture. It was judged of by results. It was judged of largely by the eye. It was "white," it was "mottled," it was "grey." It was known to be "fit for refining," fit for "strong castings," or fit for castings in which great fluidity in the molten metal was judged to be of more importance than strength in the finished casting. With respect to wrought iron, it was judged of by its results also. It was judged of by the place of its manufacture—but when the works of the district were unknown, the iron, on being tested, was classed as "good fibrous," although some of the very best was "steel-like," or "bad," "hot-short," or "cold-short." A particular district would produce one kind of iron, another district another kind of iron. The ore, the flux, and the fuel were all known to have influence, but to what extent was but little realised; and if there came in a new ore, or a new flux, it might well be that for months the turn-out of the works into which these novelties had been introduced would be prejudiced. Steel again—that luxury of the days of my youth—was judged by the eye. The wrought bars, made into "blister" steel by "cementation," were broken, examined, and grouped accordingly. Steel was known, no doubt, to be a compound of iron and carbon, but the importance of exactness in the percentage was but little understood, nor was it at all understood how the presence of comparatively small quantities of foreign matter might necessitate the variation of the proportions of carbon. The consequence was that anomalous results every now and then arose to confound the person who had used the steel, and falsifying the proverb "true as steel," steel became an object of distrust. Is it too much to say that Bessemer's great invention of steel made by the "converter," and that Siemens's invention of the open-hearth process, reacted on pure science, and set scientific men to investigate the laws which regulate the union of metals and of metalloids?—and that the labours of these scientific men have improved the manufacture, so that steel is now thoroughly and entirely trusted? By its aid engineering works are accomplished which, without that aid, would have been simply impossible. The Forth Bridge, the big gun, the compound armour of the ironclad with its steel face, the projectile to pierce that steel face—all equally depend upon the "truth" of steel as much as does the barely visible hair-spring of the chronometer, which enables the longitude of the ship in which it is carried to be ascertained. Now, what makes the difference between trustworthy and untrustworthy steel for each particular purpose? Something which, until our better sense comes to our aid, we are inclined to look upon as ridiculously insignificant—a "next-to-nothing." Setting extraneous ingredients aside, and considering only the union of iron and carbon, the question whether there shall be added or deducted one-tenth of 1 per cent. (pardon my clumsy way of using the decimal system) of carbon is a matter of great importance in the resulting quality of the steel. This is a striking practical instance of how apparently insignificant things may be of the highest importance. The variation of this fraction of a percentage may render your boiler steel untrustworthy, may make the difference between safety in a gun and danger in a gun, and may render your armour-piercing projectile unable to pierce even the thinnest wrought-iron armour.

While thus brought incidentally to the subject of guns, let me derive from it another instance of the value of small things. I have in my hand a piece of steel ribbon. It is probable that only those who are near to me can see it. Its dimensions are one-fourth by one-sixteenth of an English inch, equal to an area of one sixty-fourth of a square inch. This mode of stating the dimensions I use for the information of the ladies. To make it intelligible to my scientific friends, I must tell them that it is approximately ·00637 of a metre, by approximately ·00159 of a metre, and that its sectional area is ·0000101283 (also approximately) of a square metre. This insignificant (and speaking in reference to the greater number of my audience), practically invisible piece of material—that I can bend with my hand, and even tie into knots, is, nevertheless, not to be despised. By it one reinforces the massive and important-looking A tube of a 9·2-inch gun, so that from that tube can be projected with safety a projectile weighing 380 lbs. at a velocity when leaving the muzzle of between one-third and one-half of a mile in a second, and competent to traverse nearly 12½ miles before it touches the ground. It may be said, "What is the use of being able to fire a projectile to a distance which commonly is invisible (from some obstacle or another) to the person directing the gun?" I will suggest to you a use. Imagine a gun of this kind placed by some enemy who, unfortunately, had invaded us, and had reached Richmond. He has the range-table for his gun; he, of course, is provided with our Ordnance maps, and he lays and elevates the gun at Richmond, with the object of striking, say, the Royal Exchange. Suppose he does not succeed in his exact aim. The projectile goes 100 yards to one side or the other, or it falls 250 yards short or passes 250 yards over; and it would be "bad shooting" indeed, in these days, if nearly every projectile which was fired did not fall somewhere within an area such as this. In this suggested parallelogram of 100,000 square yards, or some twenty acres, there is some rather valuable property; and the transactions which are carried on are not unimportant. It seems to me that business would not be conducted with that calmness and coolness which are necessary for success, if, say every five minutes, a 380 lbs. shell fell within this area, vomiting fire, and scattering its walls in hundreds of pieces, with terrific violence, in all directions. Do not suppose I am saying that similar effects cannot be obtained from a gun where wire is not employed. They can be. But my point is, that they can also be obtained by the aid of the insignificant thing which I am holding up at this moment—this piece of steel ribbon, which looks more suitable for the framework of an umbrella.

I have already spoken to you, when considering steel as a mere alloy of iron and carbon, as to the value of even a fraction of 1 per cent. of the latter; but we know that in actual practice steel almost always contains other ingredients. One of the most prominent of these is manganese. It had for years been used, in quantities varying from a fraction of 1 per cent. up to 2·5 per cent., with advantage as regards ductility, and as regards its ability to withstand forging. A further increase was found not to augment the advantage: a still further increase was found to diminish it: and here the manufacturer stopped, and, so far as I know, the pure scientist stopped, on the very reasonable ground that the point of increased benefit appeared to have been well ascertained, and that there could be no advantage in pursuing an investigation which appeared only to result in decadence. But this is another instance of how the application of science reacts in the interests of pure science itself. One of our steel manufacturers, Mr. Hadfield, determined to pursue this apparently barren subject, and in doing so discovered this fact—that, while with the addition of manganese in excess of the limit before stated, and up to as much as 7 per cent., deterioration continued, after this latter percentage was passed improvement again set in.

Again, the effects of the addition of even the very smallest percentages of aluminium upon the steel with which it may be alloyed are very striking and very peculiar, giving to the steel alloy thus produced a very much greater hardness, and enabling it to take a much brighter and more silver-like polish. Further, the one-twentieth part of 1 per cent. of aluminium, when added to molten wrought iron, will reduce the fusing-point of the whole mass some 500 degrees, and will render it extremely fluid, and thus enable wrought iron (or what are commercially known as "mitis"—castings of the most intricate character) to be produced.

No one has worked more assiduously at the question of the effect of the presence of minute quantities, even traces, of alloys with metals than Professor Roberts-Austen, and he appears by his experiments, to be discovering a general law, governing the effect produced by the mixture of particular metals, so that, in future, it is to be hoped, when an alloy is, for the first time, to be attempted, it will be possible to predict with reasonable certainty what the result wil be, instead of that result remaining to be discovered by experiment.

I have just, incidentally, mentioned aluminium. May I say that we engineers look forward, with much interest, to all processes tending to bring this metal, or its alloys, within possible commercial use?

One more instance of the effect of impurities in metals. The engineer engaged in electrical matters is compelled, in the course of his daily work, frequently to realise the importance of the "next-to-nothing." One striking instance of this is afforded by the influence which an extremely minute percentage of impurity has on the electrical conductivity of copper wire: this conductivity being in some cases reduced by as much as 50 per cent, in consequence of the admixture of that which, under other circumstances, would be looked upon as insignificant.

Reverting to the question of big guns. According to the present mode of manufacture, after we have rough-bored and turned the "A" tube (and perhaps I ought to have mentioned that by the "A" tube is meant the main piece of the gun, the innermost layer, if I may so call it, that portion which is the full length of the gun, and upon which the remainder of the gun is built up)—after, as I have said, we have rough-bored and turned this "A" tube, we heat it to a temperature lying between certain specified limits, but actually determined by the behaviour of samples previously taken, and then suddenly immerse it perpendicularly into a well some 60 feet deep, full of oil, the oil in this well being kept in a state of change by the running into it, at the bottom, of cold oil conveyed by a pipe proceeding from an elevated oil tank. In this way the steel is oil-hardened, with the result of increasing its ultimate tensile strength, and also with the result of raising its so-called elastic limit. In performing this operation it is almost certain that injurious internal strains will be set up: strains tending to produce self-rupture of the material. Experiments have been carried out in England, by Captain Andrew Noble, and by General Maitland of the Royal Gun Factory, by General Kalakoutsky, in Russia, and also in the United States, to gauge what is the value, as represented by dimensions, of these strains, and we find that they have to be recorded in the most minute fractions of an inch, and yet, if the steel be of too "high" a quality (as it is technically called), or if there has been any want of uniformity in the oil-hardening process, these strains, unless got rid of or ameliorated by annealing, may, as I have said, result in the self-rupture of the steel.

I have spoken of the getting rid of the strains by annealing, a process requiring to be conducted with great care, so as not to prejudice the effects of the oil-hardening. But take the case of a hardened steel projectile, hardened so that it will penetrate the steel face of compound armour. In that case annealing cannot be resorted to, for the extreme hardness of the projectile must not be in the least impaired. The internal strains in these projectiles are so very grave, that for months after they are made there is no security that they will not spontaneously fracture. I have here the point of an 8-inch projectile, which projectile weighs 210 lbs., this with others was received from the makers as long ago as March of this year, and remained an apparently perfect and sound projectile until about the middle of August—some five months after delivery, and, of course, a somewhat longer time since manufacture—and between August 6th and 8th this piece which I hold in my hand, measuring $3\frac{3}{4}$ inches by $3\frac{1}{2}$ inches, spontaneously flew off from the rest of the projectile, and has done so upon a surface of separation which, whether having regard to its beautiful regularity, or to the conclusions to be drawn from it as to the nature of the strains existing, is of the very highest scientific interest. Many other cases of self-rupture of similar projectiles have been recorded.

Another instance of the effect of the "next-to-nothing" is the hardening and tempering or annealing of steel. As we know, the iron and the carbon (leaving other matters out of consideration) are there. The carbon is (even in tool-steel) a very small proportion of the whole. The steel may be bent, and will retain the form given to it. You heat it and plunge it in cold water; you attempt to bend it and it breaks; but if, after the plunging in cold water, you temper it by carefully reheating it, you may bring it to the condition fit either for the cutting-tool for metal, or for the cutting-tool for wood, or for the watch-spring; and these important variations of condition which are thus obtained depend upon the "next-to-nothing" in the temperature to which it is reheated, and therefore in the nature of the resulting combination of the ingredients of which the steel is composed.

Some admirable experiments were carried out on this subject by the Institution of Mechanical Engineers, with the assistance of one of our Vice-Presidents, Sir Frederick Abel, and the subject has also been dealt with by an eminent Russian writer.

There is, to my mind, another and very striking popular instance (if I may use the phrase) of the importance of attention to detail—that is, to the "next-to-nothing." Consider the bicycles and tricycles of the present day—machines which afford the means of healthful exercise to thousands, and which will, probably within a very short time, prove of the very greatest possible use for military purposes. The perfection to which these machines have been brought is almost entirely due to strict attention to detail; in the selection of the material of which the machines are made; in the application of pure science (in its strictest sense) to the form and to the proportioning of the parts, and also in the arrangement of these various parts in relation the one to the other. The result is that the greatest possible strength is afforded with only the least possible weight, and that friction in working has been reduced to a minimum. All of us who remember the hobby-horse of former years, and who contrast that machine with the bicycle or tricycle of the present day, realise how thoroughly satisfactory is the result of this attention to detail—this appreciation of the "next-to-nothing."

Let me give you another illustration of the importance of small things, drawn from gunnery practice.

At first sight one would be tempted to say that the density of the air on the underside of a shot must, notwithstanding its motion of descent, be so nearly the same as that of the air upon the upper side as to cause the difference to be unworthy of consideration, but we know that the projectiles from rifled guns tend to travel sideways as they pass through the air, and that the direction of their motion, whether to the right or to the left, depends on the "hand" of the rifling. We know also, that the friction against liquid or against gaseous bodies varies with the densities of these bodies, and it is believed that, minute as is the difference in density to which I have referred, it is sufficient to determine the lateral movement of the projectile. This lateral tendency must be allowed for, in these days of long ranges, in the sighting and laying of guns, if we desire accuracy of aim, at those distances at which it is to be expected our naval engagements will have to be commenced, and perhaps concluded. We can no longer afford to treat the subject as Nelson is said to have treated it, in one of his letters to the Secretary of the Admiralty, who had requested that an invention for laying guns more accurately should be tried. Nelson said he would be glad to try the invention, but that, as his mode of fighting consisted in placing his ship close alongside that of his enemy, he did not think the invention, even if it were successful, would be of much use to him.

While upon the question of guns, I am tempted to remark upon that which is by no means a small thing (for it is no less than the rotation of the earth), which in long-distance firing may demand attention, and that to an extent little suspected by the civilian.

Place the gun north and south, say in the latitude of London, and fire a 12-mile round such as I have mentioned, and it will be found that, assuming the shot were passing through a vacuum, a lateral allowance of more than 200 feet must be made to compensate for the different velocity of the circumference of the earth at 12 miles north or south of the place where the gun was fired, as compared with the velocity of the circumference of the earth at that place itself—the time of flight being, in round numbers, one minute.

At the risk of exciting a smile, I am about to assert that engineering has even its poetical side. I will ask you to consider with me whether there may not be true poetry in the feelings of the engineer who solves a problem such as this: Consider this rock, never visible above the surface of the tide, but making its presence known by the waves which rise around it: it has been the cause of destruction to many a noble vessel which had completed, in safety, its thousands of leagues of journey, and was, within a few score miles of port; then dashed to pieces upon it. Here is this rock. On it build a lighthouse. Lay your foundations through the water, in the midst of the turmoil of the sea; make your preparations; appear to be attaining success, and find the elements are against you and that the whole of your preliminary works are ruined or destroyed in one night; but again commence, and then go on and go on until at last you conquer; your works rise above ordinary tide-level; then upon these sure foundations, obtained, it may be, after years of toil, erect a fair shaft, graceful as a palm and sturdy as an oak; surmount it with a light, itself the produce of the highest application of science; direct that light by the built-up lens, again involving the highest application of science; apply mechanism, so arranged that the lighthouse shall from minute to minute reveal to the anxious mariner its exact name and its position on the coast. When you have done all this, will you not be entitled to say to yourself, "It is I who have for ever rendered innocuous this rock which has been hitherto a dread source of peril"! Is there no feeling, do you think, of a poetical nature excited in the breast of the engineer who has successfully grappled with a problem such as this?

Another instance: The mouth of a broad river, or, more properly speaking, the inlet of the sea, has to be crossed at such a level as not to impede the passage of the largest ships. Except in one or two places the depth is profound, so that multiple foundations for supporting a bridge become commercially impossible, and the solution of the problem must be found by making, high in the air, a flight of span previously deemed unattainable. Is there no poetry here? Again, although the results do not strike the eye in the same manner, is there nothing of poetry in the work, that has to be thought out and achieved, when a wide river or an ocean-channel has to be crossed by a subterranean passage? Works of great magnitude of this character have been performed with success, and to the benefit of those for whose use they were intended. One of the greatest and most noble of such works, encouraged, in years gone by by the Governments of our own country and of France, has lately fallen into disfavour with an unreasoning public, who have not taken the pains to ascertain the true state of the case.

Surely it will be agreed that the promotion of ready intercourse and communication between nations constitutes the very best, and most satisfactory guarantee for the preservation of peace; when the peoples of two countries come to know each other intimately, and when they, therefore, enter into closer business relations, they are less liable to be led away by panic or by anger, and they hesitate to go to war the one with the other. It is in the interests of both that questions of difference which may arise between them should be amicably settled, and having an intimate knowledge of each other, they are less liable to misunderstand, and the mode of determination of their differences is more readily arranged. Remember, the means of ready intercourse and of communication, and the means of easy travel, are all due to the application of science by the engineer. Is not, therefore, his profession a beneficent one?

Further, do you not think poetical feeling will be excited in the breast of that engineer who will in the near future solve the problem (and it certainly will be solved when a sufficiently light motor is obtained) of travelling in the air—whether this solution be effected by enabling the self-suspended balloon to be propelled and directed, or perhaps, better still, by enabling not only the propulsion to be effected and the direction to be controlled, but by enabling the suspension in the air itself to be attained by mechanical means?

Take other functions of the civil engineer, functions which, after all, are of the most important character, for they contribute directly to the prevention of disease, and thereby not only prolong life, but do that which is probably more important, afford to the population a healthier life while lived.

In one town, about which I have full means of knowing, the report has just been made that in the year following the completion of a comprehensive system of sewerage, the deaths from zymotic diseases had fallen from a total of 740 per annum to a total of 372, practically one-half. Has the engineer no inward satisfaction who knows such results as these have accrued from his work?

Again, consider the magnitude and completeness of the water-supply of a large town, especially a town that has to depend upon the storing-up of rain-water: the prevision which takes into account, not merely the variation of the different seasons of the year, but the variation of one year from another; that, having collated all the stored-up information, determines what must be the magnitude of the reservoirs to allow for at least three consecutive dry years, such as may happen; and that finds the sites where these huge reservoirs may be safely built.

All these, and many other illustrations which I could put before you if time allowed, appear to me to afford conclusive evidence that, whether it be in the erection of the lighthouse on the lonely rock at sea; whether it be in the crossing of rivers, or seas, or arms of seas by bridges or by tunnels; whether it be the cleansing of our towns from that which is foul; whether it be the supply of pure water to every dwelling, or the distribution of light or of motive power; whether it be in the production of the mighty ocean steamer, or in the spanning of valleys, the piercing of mountains, and affording the firm, secure road for the express train; or whether it be the encircling of the world with telegraphs—the work of the Civil Engineer is not of the earth, earthy, is not mechanical to the exclusion of science, is not unintellectual; but is of a most beneficent nature, is consistent with true poetical feeling, and is worthy of the highest order of intellect.

ABSTRACT OF THE ADDRESS TO THE MATHEMATICAL AND PHYSICAL SECTION OF THE BRITISH ASSOCIATION,

By Professor G. F. Fitzgerald, M.A., F.R.S., President of the Section.

In a presidential address on the borderlands of the known delivered from this chair, the great Clerk Maxwell spoke of as an undecided question whether electro-magnetic phenomena are due to a direct action at a distance or are due to the action of an intervening medium. The year 1888 will be ever memorable as the year in which this great question has been experimentally decided by Hertz in Germany and, I hope, by others in England. It has been decided in favour of the hypothesis that these actions take place by means of an intervening medium. Although there is nothing new about the question, and although most workers at it have long been practically satisfied that electro-magnetic actions are due to an intervening medium, I have thought it worth while to try and explain to others who may not have considered the problem what the problem is and how it has been solved.

An illustrative example may make the question itself clearer, and so lead you to understand the answer better. In colloquial language we may say that balloons, hot air, etc., rise because they are light. In old times this was stated more explicitly, and therefore much more clearly. It was said that they possessed a quality called "levity." "Levity" was opposed to "heaviness." Heaviness made things tend downwards, levity made things tend upwards. It was a sort of action at a distance. At least it would have required such a hypothesis if it had survived until it was known that heaviness was due to the action of the earth. I expect levity would have been attributed to the direct action of heaven. It was comparatively recently in the history of mankind that the rising of hot air, flames, etc., was attributed to the air. Everybody knew that there was air, but it was not supposed that the upward motion of flames was due to it. We now know that this and the rising of balloons are due to the difference of pressure at different levels in the air. In a similar way we have long known that there is an ether, an all-pervading medium, occupying all known space. Its existence is a necessary consequence of the undulatory theory of light. People who think a little but not much sometimes ask me, "Why do you believe in the ether? What's the good of it?" I ask them, "What becomes of light for the eight minutes after it has left the sun and before it reaches the earth?" When they consider that they observe how necessary the ether is. If light took no time to come from the sun there would be no need of the ether. That it is a vibratory phenomenon, that it is affected by matter it acts through—these could be explained by action at a distance very well. The phenomena of interference would, however, require such complicated and curious laws of action at a distance as practically to put such a hypothesis out of court or else be purely mathematical expressions for wave propagation. In fact, anything except propagation in time is explicable by action at a distance. It is the same in the case of electro-magnetic actions. There were two hypotheses as to the causes of electro-magnetic actions. One attributed electric attraction to a property of a thing called electricity, to attract at a distance, the other attributed it to a pull exerted by means of the ether, somewhat in the way that air pushes balloons up. We do not know what the structure of the ether is by means of which it can pull, but neither do we know what the structure of a piece of india-rubber is by means of which it can pull, and we might as well ignore the indiarubber, though we know a lot about the laws of its action, because we do not know its structure, as to ignore the ether because we do not know its structure. Anyway, what was wanted was an experiment to decide between the hypothesis of direct action at a distance and of action by means of a medium. At the time that Clerk Maxwell delivered his address no experiment was known that could decide between the two hypotheses. Specific inductive capacity, the action of intervening matter, the delay in telegraphing, the time propagation of electro-magnetic actions by means of conducting material—these were known, but he knew that they could be explained by means of action at a distance, and had been so explained. Waves in a conductor do not necessarily postulate action through a medium such as the ether. When we are dealing with a conductor and a thing called electricity running over its surface, we are, of course, postulating a medium on or in the conductor, but not outside it, which is the special point at issue. Clerk Maxwell *believed* that just as the same air that transmits sound is able by differences of pressure—*i.e.*, by means of its energy per unit volume—to move bodies immersed in it, so the same ether that transmits light causes electrified bodies to move by means of its energy per unit volume. He believed this, but there was no experiment known then to decide between this hypothesis and that of direct action at a distance. As I have endeavoured to impress upon you, no *experimentum crucis* between the hypotheses is possible except an experiment proving propagation in time either directly, or indirectly by an experiment exhibiting phenomena like those of the interference of light. A theorist may speak of propagation of actions in time without talking of a medium. This is all very well in mathematical formulæ, but, as in the case of light, we must consider what becomes of it after it has left the sun and before it reaches the earth, so every hypothesis assuming action in time really postulates a medium whether we talk about it or not. There are some difficulties surrounding the complete interpretation of some of Hertz's experiments. The conditions are complicated, but I confidently expect that they will lead to a decision on most of the outstanding questions on the theory of electro-magnetic action. However, there is no doubt that he has observed the interference of electro-magnetic waves quite analogous to those of light, and that he has proved that electro-magnetic actions are propagated in air with the velocity of light. By a beautiful device Hertz has produced rapidly alternating currents of such frequency that their wave length is only about two mètres. I may pause for a minute to call your attention to what that means. These waves are propagated three hundred thousand kilomètres in a second. If they vibrated three hundred thousand times a second the waves would be each a kilomètre long. This rate of vibration is much higher than the highest audible note, and yet the waves are much too long to be manageable. We want a vibration about a thousand times as fast again with waves about a mètre long. Hertz produced such vibrations, vibrating more than a hundred million times a a second. That is, there are as many vibrations in one second as there are seconds—in a day? No, far more. In a week? No, more even than that. The pendulum of a clock ticking seconds would have to vibrate for four months before it would vibrate as often as one of Hertz's vibrators vibrates in one second. And how did he detect the vibrations and their interference? He could not see them; they are much too slow for that; they should go about a million times as fast again to be visible. He could not hear them; they are much too quick for that. If they went a million times more slowly they would be well heard. He made use of the principle of resonance. You all understand how by a succession of well-timed small impulses a large vibration may be set up. It explains many things, from speech to spectrum analysis. It is related that a former Marquess of Waterford used the principle to overturn lamp-posts; his ambition soared above knocker-wrenching. So that it is a principle known to others besides scientific men. Hertz constructed a circuit whose period of vibration for electric currents was the same as that of his generating vibrator, and he was able to see sparks, due to the induced vibration, leaping across a small air-space in this resonant circuit. The well-timed electrical impulses broke down the air-resistance just as those of my Lord of Waterford broke down the lamp-post. The combination of a vibrating generating circuit with a resonant-receiving circuit is one that I spoke of at the meeting of the British Association at Southport as one by which this very question might be studied. At the time I did not see any feasible way of detecting the induced resonance; I did not anticipate that it could produce sparks. By its means, however, Hertz has been able to observe the interference between waves incident on a wall and the reflected waves. He placed his generating vibrator several wave lengths away from a wall, and placed the receiving resonant circuit between the generator and the wall, and in this air-space he was able to observe that at some points there were hardly any induced sparks, but at other and greater distances from his generator they reappeared to disappear again in regular succession at equal intervals between his generator and the wall. It is exactly the same phenomenon as what are known as Lloyd's bands in optics, which are due to the interference between a direct and a reflected wave. It follows hence that, just as Young's and Fresnell's researches on the Interference of Light prove the undulatory theory of optics, so Hertz's experiment proves the ethereal theory of electro-magnetism. It is a splendid result. Henceforth I hope no learner will fail to be impressed with the theory—hypothesis no longer—that electro-magnetic actions are due to a medium pervading all known space, and that it is the same medium as the one by which light is propagated, that non-conductors can, and probably always do, as Professor Poynting has taught us, transmit electro-magnetic energy. By means of variable currents energy *is* propagated into space with the velocity of light. The rotation of the earth is being slowly stopped by the diurnal rotation of its magnetic poles. This seems a hopeful direction in which to look for an explanation of the secular precession of terrestrial magnetism. It is quite different from Edlund's curious hypothesis that free space is a perfect conductor. If this were true, there would be a pair of great antipoles outside the air, and terrestrial magnetism would not be much like what it is, and I think the earth would have stopped rotating long ago. With alternating currents we *do* propagate energy through non-conductors. It seems almost as if our future telegraph cables would be pipes. Just as the long sound waves in speaking tubes go round corners, so these electro-magnetic waves go round corners if they are not too sharp. Professor Lodge will probably have something to tell us on this point in connection with lightning conductors. The silvered glass-bars used by surgeons to conduct light are exactly what I am describing. They are a glass, a non-conducting, and therefore transparent, bar surrounded by a conducting, and therefore opaque, silver sheath, and they transmit the rapidly alternating currents we call light. There would not be the same difficulty in utilising the energy of these electro-magnetic waves as in utilising radiant heat. Having all the vibrations of the same period we might utilise Hertz's resonating circuits, and in any case the second law of thermodynamics would not trouble us when we could practically attain to the absolute zero of these, as compared with heat, long period vibrations.

We seem to be approaching a theory as to the structure of the ether. There are difficulties from diffusion in the simple theory that it is a fluid full of motion, a sort of vortex sponge. There were similar difficulties in the wave theory of light owing to wave propagation round corners, and there is as great a difficulty in the jelly theory of the ether arising from the freedom of motion of matter through it. It may be found that there is diffusion or it may be found that there are polarised distributions of fluid kinetic energy which are not unstable when the surfaces are fixed; more than one such is known. Osborne Reynolds has pointed out another, though in my opinion less hopeful, direction in which to look for a theory of the ether. Hard particles are abominations. Perhaps the impenetrability of a vortex would suffice. Olive Lodge speaks confidently of a sort of chemical union of two opposite kinds of elements forming the ether. The opposite sides of a vortex ring might perchance suit, or maybe the ether, after all, is but an atmosphere of some infra-hydrogen element; these two latter hypotheses may both come to the same thing. Anyway we are learning daily what sort of properties the ether must have. It must be the means of propagation of light; it must be the means by which electric and magnetic forces exist; it should explain chemical actions, and, if possible, gravity.

On the vortex-sponge theory of the ether there is no real difficulty by reason of complexity why it should not explain chemical actions. In fact, there is every reason to expect that very much more complex actions would take place at distances comparable with the size of the vortices than at the distances at which we study the simple phenomena of electro magnetism. Indeed, if vortices can make a small piece of a strong elastic solid we can make watches and build steam engines and any amount of complex machinery, so that complexity can be no essential difficulty. Similarly the instantaneous propagation of gravity, if it exists, is not an essential difficulty, for vortices each occupy all space, and they act on one another simultaneously everywhere. The theory that material atoms are simple vortex rings in a perfect liquid otherwise unmoving is insufficient, but with the innumerable possibilities of fluid motion it seems almost impossible but that an explanation of the properties of the universe will be found in this conception. Anything purporting to be an explanation founded on such ideas as "an inherent property of matter to attract," or building up big elastic solids out of little ones, is not of the nature of an ultimate explanation at all; it can only be a temporary stopping place. There are metaphysical grounds, too, for reducing matter to motion and potential to kinetic energy.

These ideas are not new, but it is well to enunciate them from time to time, and a presidential address in Section A is a fitting time. Besides all this it has become the fashion to indulge in quaint cosmical theories and to dilate upon them before learned societies and in learned journals. I would suggest, as one who has been bogged in this quagmire, that a successor in this chair might well devote himself to a review of the cosmical theories propounded within the last few years. The opportunities for piquant criticism would be splendid.

Returning to the sure ground of experimental research let us for a moment contemplate what is betokened by this theory that in electro-magnetic engines we are using as our mechanism the ether, the medium that fills all known space. It was a great step in human progress when man learnt to make material machines, when he used the elasticity of his bow and the rigidity of his arrow to provide food and defeat his enemies. It was a great advance when he learnt to use the chemical action of fire; when he learnt to use water to float his boats and air to drive them; when he used artificial selection to provide himself with food and domestic animals. For two hundred years he has made heat his slave to drive his machinery. Fire, water, earth, and air have long been his slaves, but it is only within the last few years that man has won the battle lost by the giants of old, has snatched the thunderbolt from Jove himself and enslaved the all-pervading ether.

ABSTRACT OF THE ADDRESS TO THE CHEMICAL SECTION OF THE BRITISH ASSOCIATION.

By Professor William A. Tilden, D.Sc. Lond, F.R.S., F.C.S., President of the Section.

The fact that at the last meeting of the Association a Committee was appointed to inquire into the methods at present adopted for teaching chemistry suggested that, as I had not been able to accept an invitation to join this Committee, I might make use of this opportunity for contributing to the discussion. The first report of the Committee will be received with much interest by the Section. As might be expected, it embodies the expression of many varieties of opinion.

The existence of chemistry as a department of science not merely requiring the observation of facts that are to be made useful, but seeking in the accumulated stores of observation to discover law, is a thing of comparatively recent growth. How chemistry arose out of alchemy I need not remind you, but the connection between the study of chemistry and that of medicine, and the maintenance of this connection down to even the present generation, is illustrated by the fact that a large number of men who have become eminent as chemists began their career in the surgery or the pharmacy. Black, Davy, Berzelius, Wollaston, Wöhler, Wurtz, Andrews, and W. A. Miller began by the study of medicine, whilst Scheele, H. Rose, and the great names of Liebig and Dumas are to be found in the long roll of those who received their earliest notions of chemistry in the pharmaceutical laboratory. Chemistry has been gradually emancipated from these associations with enormous advantage to both sides. So long as technical purposes alone were held in view a scientific chemistry could not exist, but no sooner did the study take an independent form and direction than multitudes of useful applications of the facts discovered became apparent.

In the old time such instruction in chemistry as was given in the universities and mining or technical schools seems to have taken the form of lectures read by the Professor, and access to a laboratory for practical manipulation seems to have been a high privilege, accorded only under exceptional circumstances to the few. We are told, for example, that when Liebig went to Paris in 1823 he applied to Gay-Lussac for practical instruction at first without success, and that admission to the laboratory of the Ecole Polytechnique was ultimately granted him only through the intervention of Von Humboldt.

Doubtless, therefore, the recollection of his own early difficulties when seeking instruction contributed largely to influence Liebig in the establishment of the laboratory in the University of Giessen, and in the adoption of the principles which guided his teaching there. For the first time in the history of chemistry, students met not merely to listen to the discourse of a professor concerning his own experiments and conclusions, but to examine for themselves the basis of the theories taught, to learn the processes of analysis, and by independent investigation to extend the boundaries of existing knowledge.

The fame of the new school spread fast and far, and soon men from every part of the civilised world assembled to share in the advantages offered. The influence of the new method can be estimated when we reflect that nearly all the now passing generation of chemists in England and America obtained the greater part of their training in Liebig's laboratory; and as a large number of them have been teachers, it may be assumed that they transplanted into their own countries the methods they had learnt from the great German master.

It was not till 1846, long after the school at Giessen had risen into fame, that in England a sense of our deficiencies in respect to provision for teaching chemistry was felt strongly enough to lead to the establishment of a college of chemistry. At that time the Professor of Chemistry at Oxford was also Professor of Botany. At Cambridge it was thought praise and boast enough that the occupant of the chair of chemistry had, during more than thirty years, frequently resided at the University, and every year gave a course of lectures. The Jacksonian professorship was not then, as now, in the possession of a chemist. University College, London, had at this period a very distinguished man in the chair of chemistry, but it was only in 1848 that a commodious laboratory was provided by public subscription, raised in commemoration of the services of Dr. Birkbeck in promoting popular education. In that year Fownes was appointed to co-operate with Graham in the work of teaching, though his premature death soon after left but little time for the fulfilment of the rich promise of his earlier days. At Manchester John Owens had died in 1846, leaving the bulk of his estate for the purpose of establishing a university in Manchester, but as yet the Owens College was not.

The foundation of the College of Chemistry in 1846 was therefore an event of supreme importance in the history of chemical teaching in this country.

Since then the means of instruction in science in England have multiplied enormously. In University College, London, founded in 1828, and in Owens College, Manchester, founded in 1851, not only have chairs of chemistry existed from the first, but they have been occupied by a succession of chemists of the highest eminence. But long after 1846 the whole of the serious teaching of scientific chemistry was accomplished at the College of Chemistry, and it was nigh upon twenty years before the Manchester school began to attract considerable notice.

In 1872-3 the movement set in which has resulted in the erection of colleges for higher instruction at a number of important English and Welsh towns. These, together with the pre-existent Queen's Colleges in Ireland and the Universities of more ancient foundation in the three kingdoms, are for the most part provided with pretty good laboratories and a competent staff. We have also the Normal School of Science and the Institute raised by the City and Guilds of London at South Kensington, and its Associate College at Finsbury. England is therefore at the present time as well provided with *places* of instruction for the study of chemistry as any country in the world.

It is nevertheless true that increased opportunities for study, a considerable supply of capable teachers, and an enormous body of students have not produced such an amount of original investigation, or even of accurate analytical work, as might reasonably be expected. A full and complete explanation of all the influences which contribute to this result would be difficult; but I think the apparent inactivity of the chemical schools in this country is not generally the fault of the professors, but is chargeable in the main to the ignorance, and partly to the indifference, of the public.

In the case of chemistry the absence of sentiment in favour of concentration and thoroughness, and the demand for superficiality, if only it can be had wholesale, tells in a variety of ways. The governing bodies who control the various colleges and universities, and the public generally, cannot understand that good and useful work is being done unless it can be shown in the form of passes at examinations. Though I most firmly believe in the necessity for examinations, serious mischief begins when they are regarded as the end itself, and not as mere incidents in the student's career towards the end, which should be knowledge.

Reflect also upon the fact that there are only two or three colleges in this country which can boast of more than one professor of chemistry. In nearly all cases one man is called upon to discharge the duty of teaching classes both elementary and advanced, in pure and applied chemistry, inorganic and organic, theoretical and practical. This is a kind of thing which kills specialism, and without specialists we can have not only no advance, but no efficient teaching of more than rudiments.

That teachers ought to engage in research at all is by no means clear to the public and to those representatives of the public who are charged with the administration of these new institutions. Without going far into the discussion of the general question, which is a large one, I may perhaps be allowed to offer a few remarks for the consideration of any of my audience who may perchance incline towards that opinion.

It is only when a teacher occupies himself with research that the most complete guarantee is given that he is interested in his subject and that he is a learner. A popular mistake consists in regarding a professor as a living embodiment of science—complete, infallible, mysterious; whereas in truth he is, or ought to be, only a senior student who devotes the greater part of his time to extending and consolidating his own knowledge for the benefit or those who come to learn of him, not only what lies within the boundaries of the known, but how to penetrate into the far greater region of the unknown. Moreover, the man who has no intellectual independence and simply accepts other people's views without challenge is pretty certain to make the stock of knowledge with which he sets out in life do service to the end. That one may be fitted to form a sound judgment concerning new theories he must be familiar with the methods by which progress is accomplished. The work of investigation then reacts beneficially upon the work of teaching; that is why teachers should be encouraged, nay even required, to investigate, and not because their discoveries may haply prove to be practically useful.

Of course it may be said that there have been distinguished investigators who could not teach, but the converse is not true; every teacher who has attained to eminence as a teacher, who has drawn men after him, who has founded a school of thought, and has left his mark upon his generation, has been an industrious worker in research of some kind. All teachers cannot be expected to reach the same high standard, but this is the ideal after which all must strive, or fail utterly.

The fact that there is as yet little demand among schoolmasters for high attainments in chemistry is another reason why so little is accomplished in the chemical schools. Here again the public is really to blame. It is disgraceful that in all classes of schools, even where chemistry is supposed to be taught, there are but few places where serious employment is found for the well trained chemist. I could point to several schools which claim the position of first-rate, where chemistry is taught by masters who have never studied the subject at all, but who are, I suppose, allowed the traditional "ten minutes' start" with the book. Would the head-masters of such places dare to employ a person to teach mathematics who did not know the four first rules of arithmetic, or another to teach Latin who had not even got through the accidence? I fancy not. This, however, is without exaggeration the exact parallel of the position in which chemistry is placed in the majority of schools.

There is an opportunity at the present time of correcting some of these mistakes, but no advantage is being taken of it. I refer now to the "technical schools" which are springing up everywhere. There may be a few competent teachers of chemistry employed in some of them, but I find it difficult to think of many examples. The sort of person who is put in charge of these places is usually a schoolmaster, who is allowed, sometimes even after his appointment, to get a short course of qualitative analysis in order to enable him to obtain a certificate which will entitle him to earn grants from the Science and Art Department.

Three years has hitherto been regarded as the normal period for study. The question arises, can a young man, previously well educated, expect to become an accomplished chemist, competent to apply his knowledge usefully, by giving the whole of his time to study during *three years*? I believe not.

By reason of the enormous development of the science the position of the student of chemistry is nowadays very different from what it was thirty years ago. Since that time we have not only got a few new elements, a matter of small importance in itself, but new views of the nature of the elements and of their mutual relations. This could hardly have come about but for the recognition of the law of Avogadro as a fundamental principle, upon which we rely as the ultimate criterion by which the true distinction between so-called equivalent weights and molecular ratios has been established. By the gradual evolution of ideas having reference successively to the electro-chemical relations of elements and compounds, the theory of types, and atomicity or valency, we have arrived at notions of chemical constitution based upon the hypothesis of the orderly linking together of atoms. Thirty years ago isomerism had scarcely attracted notice, and carbon compounds were only just beginning to be arranged in homologous series. The general use at the present day of the language of the molecular kinetic theory shows how deeply this theory influences our ideas of the internal constitution of matter. Within the period referred to, dissociation has been studied, and a vast body of thermo-chemical data have been accumulated. And although the larger portion of the results of this work still await interpretation, dynamical ideas of chemical action are now generally accepted. We have also new methods of investigation, including spectroscopic analysis with all its vast train of results.

It has always been thought essential that a student of chemistry should have some knowledge of physics. It is now more than ever necessary that this knowledge should be extensive, sound, and based upon a good foundation of mathematics. Thirty years ago a hundred pages of Fownes contained all that was thought necessary, but no one nowadays could be satisfied with that. It is now asserted that a young chemist who expects to find a career in industrial chemistry should also have learnt drawing, and more important still that he should have a good general knowledge of mechanics, steam, and building construction. I suppose everyone will agree in adding French and especially German. You see how the requirements expand.

The inference from all this is that it now takes longer to make a chemist than formerly. This is a point of considerable practical importance.

My estimate that a well-educated and intelligent young man will now require five years for the study of chemistry and accessory subjects before he is likely to be of much use will not appear extravagant.

Here one may remark that in order to become a chemist it is before all things necessary to study chemistry. If the greater part of a student's time is to be taken up with other things it is not very clear how this is to be done.

A reform all round is wanted. The mathematics, modern languages, and drawing properly belong to the antecedent school period, and I believe the Institute of Chemistry would greatly promote the interests of the profession, if it would impose upon candidates for the Associateship not only a three years' course of training with an examination in practical chemistry at the end, but a severe examination in mathematics, in the English, French, and German languages, and perhaps drawing before matriculation or registration.

A consideration of the present position of the student of chemistry leads naturally to a review of the methods of teaching the subject. Speaking broadly, I suppose nearly all professional chemists who have had the advantage of systematic training have, up to the present time, passed through very much the same kind of course. This consists, as everybody knows, very largely of analytical work, qualitative and quantitative, preceded or followed by the preparation of a number of definite chemical compounds, besides practice in certain very necessary physical determinations, *e.g.*, relative density of solids, liquids, and gases, melting points, boiling points, and so forth. There seems now to be a disposition in some quarters to depart from this time-honoured curriculum in favour of a course in which the student is early engaged in some semblance of investigation, and in which he is encouraged to attack difficult problems, which from their fundamental importance offer considerable temptation. I venture to express a hope that this will not be carried too far. Already we are in danger of losing the art of accurate analysis. One constantly meets with young chemists who are ready enough to discuss the constitution of benzene, but who cannot make a reliable combustion. And according to my own experience, attempts at research among inexperienced chemists become abortive more frequently in consequence of deficient analytical skill than from any other cause.

But though it does not appear to me to be wise to encourage beginners, without sufficient experience or manipulative skill, to attempt original work, one of the best possible exercises preparatory to original work is to select suitable memoirs, and not only to read them but to work conscientiously through the whole of the preparations and analyses described, following the instructions given. Many of Dr. Hofmann's papers afford excellent examples. So also do the writings of Dr. Perkin and Dr. Frankland, besides those of many other chemists which could easily be selected by the teacher.

An intelligent student, possessing the requisite preliminary knowledge, would obtain much instruction by repeating the work contained in such papers as the following, for example:—Emerson Reynolds, on the "Missing Sulphur Urea" ("J. Chem. Soc.," 1869—i.); Fittig and Tollens, on the "Synthesis of Hydrocarbons of the Benzol Series" (Liebig's "Annalen," 1864, cxxxi. 303); L. Claisen and Pupils, on the "Introduction of Acid Radicles into Ketones," etc. ("Berichte," xx.); Lawson and Collie, on the "Action of Heat on Salts of Tetramethyl-Ammonium" ("J. Chem. Soc.," June, 1888); Thorpe and Hambly, on "Manganic Trioxide" ("J. Chem. Soc.," March, 1888); besides many others, including papers on analytical processes. To such as these there might subsequently be added the determination of an atomic weight on the model of one of the best masters, as a discipline which could not fail to be impressive, and full of instruction.

A number of papers, pamphlets and text-books have lately appeared, professing to teach the principles of the science practically and by new methods. Most of these turn out, upon inspection, to be very old methods indeed, but there is a small residue of distinctly original character, which are sure to attract, as they deserve, considerable attention. The systems I refer to provide a series of problems which the pupils are called upon to solve. According to this plan the student is not allowed peaceably to examine the properties of oxygen or sulphur which he now sees for the first time. He must weigh, and measure, and observe, and then infer. All this coming at once upon the head of a beginner seems to me to be well fitted to drive him to despair.

I well remember the first experiment in chemistry I ever made. It consisted in dissolving zinc in diluted sulphuric acid in an evaporating dish, lighting with a match the bubbles of hydrogen as they rose, and afterwards leaving the solution to crystallise. I was about sixteen, and the bubbles of gas as well as the crystals I afterwards got interested me very much. If at that time I had been made to weigh the zinc and acid, and measure the hydrogen with the object of answering some question about the composition of zinc and hydrogen sulphates, I should have been pretty much in the position of a boy ignorant of geometry shut up with the propositions of Euclid and ordered to give the demonstrations.

I think when we recall such a fact as that Priestley, who discovered oxygen in 1774, failed to the end of his days to understand the process of combustion, and actually wrote, in 1800, a pamphlet in defence of "phlogiston," we ought not to be surprised when young people, though born a century later, fail to perceive at once the full significance of facts to which they are introduced for the first time. At the outset you cannot reasonably expect a young student both to observe accurately and infer justly. These two things must be kept separate at first, and for this reason among others I believe that attempts to make young students verify for themselves the fundamental propositions of chemistry will not be successful. One has only to trace the origin of one's own convictions in reference to any important fact or principle to perceive that they very seldom spring into existence suddenly, but almost always commence in vagueness and hesitation, acquiring consistency and solidity only as the result of accumulated experience.

I will not pretend to determine what may be included within the wide circle of the functions of the British Association; but I think I cannot be mistaken in assuming that the advancement of science is dependent in no small degree upon the provision for the efficient teaching of science. I have traced an outline of what has been done in the past, and have endeavoured to show in what respects I think we are deficient at the present time. No matter how ardent may be the aspirations, how earnest the endeavours of the few, progress will be slow unless they are sustained by the sympathy of the many. On one principle the public must surely insist, that only those shall be allowed to teach who know.

ABSTRACT OF THE ADDRESS TO THE GEOLOGICAL SECTION OF THE BRITISH ASSOCIATION,

By W. Boyd Dawkins, M.A., F.R.S., F.G.S., F.S.A., Professor of Geology and Paleontology in Owens College, President of the Section.

Our science has made great strides during the last twenty-four years, and she has profited much from the great development of her sisters. The microscopic analysis of the rocks has opened out a new field of research, in which physics and chemistry are in friendly rivalry, and in which fascinating discoveries are being made almost day by day as to metamorphism, and the crushing and shearing forces brought to bear upon the cooling and contracting crust while the earth was young. The deep-sea explorations have revealed the structure and the deposits of the ocean abysses, and the depths supposed to be without life, like the fabled deserts in the interior of Africa, are now known to teem with varied forms glowing with the richest colours. From a comparison of these deposits with the stratified rocks we may conclude that the latter are marginal, and deposited in depths not greater than 1,000 fathoms, or the shore end of the Globigerina ooze, and most of them at a very much less depth, and that consequently there is no proof in the geological record of the ocean depths having ever been in any other than their present places.

In North America the geological survey of the Western States has brought to light an almost unbroken series of animal remains, ranging from the Eocene down to the Pleistocene Age. In these we find the missing links in the pedigree of the Horse, and sufficient vidence of transitional forms to cause Professor Flower to restore o its place in classification the order Ungulata of Cuvier. These may be expected to occupy the energies of our kinsmen on the other side of the Atlantic for many years, and to yield further proof of the truth of the doctrine of evolution. The use of this word reminds me how much we have grown since 1864, when evolution was under discussion, and when biological, physical, and geological laboratories could scarcely be said to have existed in this country. Truly may the scientific youth of to-day make the boast—

Ἡμεῖς μὲν πατέρων μέγ' ἀμείνονες εὐχόμεθ' εἶναι—

"We are much better off than our fathers were," while we, the fathers, have the poor consolation of knowing that when they are fathers their children will say the same of them. There is reason to suppose that our science will advance more swiftly in the future than it has in the past, because it has more delicate and precise methods of research than it ever had before, and because its votaries are more numerous than they ever were.

In 1864 the attention of geologists was mainly given to the investigations of the later stages of the Tertiary Period. The bent of my pursuits inclines me to revert to this portion of geological inquiry, and to discuss certain points which have arisen during the last few years in connection with the classificatory value of fossils, and the mode in which they may be best used for the co-ordination of strata in various parts of the world.

The principle of homotaxy, first clearly defined by Professor Huxley, has been fully accepted as a guiding principle in place of synchronism or contemporaneity, and the fact of certain groups of plants and animals succeeding one another in a definite order, in countries remote from each other, is no longer taken to imply that each was living in the various regions at the same time, but rather, unless there be evidence to the contrary, that they were not. While, however, there is a universal agreement on this point among geologists, the classificatory value of the various divisions of the vegetable and animal kingdoms is still under discussion, and, as has been very well put by my predecessor in this chair at Montreal, sometimes the evidence of one class of organic remains points in one direction, while the evidence of another class points in another and wholly different direction as to the geological horizon of the same rock. The Flora, put into the witness-box by the botanist, says one thing, while the Mollusca or the Vertebrata say another thing in the hands of their respective counsel. There seems to be a tacit assumption that the various divisions of the organic world present the same amount of variation in the rocks, and that consequently the evidence of every part of it is of equal value.

The cryptogamic flora of the later Primary rocks shows but slight evidence of change. The forests of Britain and of Europe generally, and of North America, were composed practically of the same elements—Sigillaria, Calamites, and conifers allied to the Ginkho—throughout the whole of the Carboniferous (16,336 feet in thickness in Lancashire and Yorkshire) and Devonian rocks, and do not present greater differences than those which are to be seen in the existing forests of France and Germany. They evidently were continuous both in space and time, from their beginning in the Upper Silurian to their decay and ultimate disappearance in the Permian Age.

The forests of the Secondary Period, consisting of various conifers and cycads, also present slight differences as they are traced upwards through the Triassic and Jurassic rocks, while remarkable and striking changes took place in the fauna, which mark the division of the formations into smaller groups. As the evidence stands at present, the cycads of the Lias do not differ in any important character from those of the Oölites or the Wealden, and the *Salisburia* in Yorkshire in the Liassic Age is very similar to that of the Island of Mull in the Early Tertiary, and to that (*Salisburia adiantifolia*) now living in the open air in Kew Gardens.

Nor do we find evidence of greater variation in the dicotyledonous forests, from their first appearance in the Cenomanian stage of the Cretaceous rocks of Europe and America, through the whole of the Tertiary Period down to the present time. In North America the flora of the Dakota series so closely resembles the Meiocene of Switzerland that Dr. Heer had no hesitation in assigning it in the first instance to the Meiocene Age.

In the Tertiary Period there is an unbroken sequence in the floras, as Mr. Starkie Gardner has proved, when they are traced over many latitudes, and most of the types still survive at the present day, but slightly altered. If, however, Tertiary floras of different ages are met with in one area, considerable differences are to be seen, due to progressive alterations in the climate and altered distribution of the land. As the temperature of the Northern Hemisphere became lowered the tropical forests were pushed nearer and nearer to the equator, and were replaced by plants of colder habit from the northern regions, until ultimately, in the Pleistocene Age, the Arctic plants were pushed far to the south of their present habitat. In consequence of this Mr. Gardner concludes that "it is useless to seek in the Arctic regions for Eocene floras as we know them in our latitudes, for during the Tertiary Period the climatic conditions of the earth did not permit their growth there. Arctic fossil floras of temperate and therefore Meiocene aspect are in all probability of Eocene age, and what has been recognised in them as a newer or Meiocene facies is due to their having been first studied in Europe in latitudes which only became fitted for them in Meiocene times. When stratigraphical evidence is absent or inconclusive, this unexpected persistence of plant types or species throughout the Tertiaries should be remembered, and the degrees of latitude in which they are found should be well considered before conclusions are published respecting their relative age."

This view is consistent with that held by the leaders in botany, Hooker, Dyer, Saporta, Dawson, and Asa Gray—whose recent loss we so deeply deplore—that the North Polar region is the centre of dispersal, from which the Dicotyledons spread over the Northern Hemisphere. If it be true—and I, for one, am prepared to accept it—it will follow that for the co-ordination of the subdivisions of the Tertiary strata in various parts of the world the plants are uncertain guides, as they have been shown to be in the case of the Primary and Secondary rocks. In all cases where there is a clash of evidence, such as in the Laramie lignites, in which a Tertiary flora is associated with a Cretaceous fauna, the verdict in my opinion must go to the fauna. They are probably of the same geological age as the deposit at Aix-la-Chapelle.

I would remark further, before we leave the floras behind us, that the migration of new forms of plants into Europe and America took place before the arrival of the higher types in the fauna, after the break-up of the land at the close of the Carboniferous period, and after the great change in geography at the close of the Neocomian. The Secondary plants preceded the Secondary vertebrates by the length of time necessary for the deposit of the Permian rocks, and the Tertiary plants preceded the Tertiary vertebrates by the whole period of the Upper Cretaceous.

Let us now turn to the fauna.

Professor Huxley, in one of his many addresses which have left their mark upon our science, has called attention to the persistence of types revealed by the study of Palæontology, or, to put it in other words, to the singularly little change which the ordinal groups of life have undergone since the appearance of life on the earth. The species, genera, and families present an almost endless series of changes, but the existing orders are for the most part sufficiently wide, and include the vast series of fossils without the necessity of framing new divisions for their reception. The number of these extinct orders is not equally distributed through the animal kingdom. Taking the total number of orders at 108, the number of extinct orders in the Invertebrata amounts only to 6 out of 88, or about 7 per cent., while in the Vertebrates it is not less than 12 out of 40, or 30 per cent. These figures imply that the amount of ordinal change in the fossil Vertebrates stands to that in the Invertebrata in the ratio of 30 to 7. This disproportion becomes still more marked when we take into account that the former had less time for variation than the latter, which had the start by the Cambrian and Ordovicean Periods. It follows also that as a whole they have changed faster.

The distribution of the extinct orders in the animal kingdom, taken along with their distribution in the rocks, proves further that some types have varied more than others, and at various places in the geological record. In the Protozoa, Porifera, and Vermes there are no extinct orders; among the Cœlenterates one: the Rugosa; in the Echinodermata three: Cystideans, Edriasterida, and Blastoidea; in the Arthropoda two: the Trilobita and Eurypterida. All these, with the solitary exception of the obscure order Rugosa, are found only in the Primary rocks. Among the Pisces there are none; in the Amphibia one; the Labyrinthodonts ranging from the Carboniferous to the Triassic Age. Among the Reptilia there are at least six of Secondary age: Plesiosauria, Ichthyosauria, Dicynodontia, Pterosauria, Theriodontia, Deinosauria; in the Aves two: the Saururæ and Odontornithes, also Secondary. In the Mammalia the Amblypoda, Tillodontia, Condylarthra, and Toxodontia represent the extinct orders—the three first Early Tertiary, and the last Pleistocene. It is clear therefore that, while the maximum amount of ordinal variation is presented by the Secondary Reptilia and Aves, all the extinct orders in the Tertiary are Mammalian.

If we turn from the extinct orders to the extinct species, it will also be found that the maximum amount of variation is presented by the plants, and all the animals, excepting the Mammalia, in the Primary and Secondary Periods.

The general impression left upon my mind by these facts is that, while all the rest of the animal kingdom had ceased to present important modifications at the close of the Secondary Period, the Mammalia, which presented no great changes in the Secondary rocks, were, to quote a happy phrase of Professor Gaudry, "en pleine évolution" in the Tertiary Age. And when, further, the singular perfection of the record allows us to trace the successive and gradual modifications of the Mammalian types from the Eocene to the close of the Pleistocene Age, it is obvious that they can be used to mark subdivisions of the Tertiary Period, in the same way as the reigns of kings are used to mark periods in human history. In my opinion they mark the geological horizon with greater precision than the remains of the lower members of the animal kingdom, and in cases such as that of Pikermi, where typical Meiocene forms, such as Deinotheria, are found in a stratum above an assemblage of marine shells of Pleiocene age, it seems to me that the Mammalia are of greater value in classification than the Mollusca, some of the species of which have been living from the Eocene down to the present day.

Yet another important principle must be noted. The fossils are to be viewed in relation to those forms now living in their respective geographical regions. The depths of the ocean have been where they are now since the earliest geological times, although continued geographical changes have been going on at their margins. In other words, geographical provinces must have existed even in the earlier geological periods, although there is reason to believe that they did not differ so much from each other as at the present day. It follows from this that the only just standard for comparison in dealing with the fossils, and especially of the later rocks, is that which is offered by the fauna and flora of the geographical province in which they are found. The non-recognition of this principle has led to serious confusion. The fauna, for example, of the Upper Sivalik Formation has been very generally viewed from the European standpoint and placed in the Meiocene, while, judged by the standpoint of India, it is really Pleiocene. A similar confusion has followed from taking the Meiocene flora of Switzerland as a standard for the Tertiary flora of the whole of the Northern Hemisphere.

It now remains for us to see how these principles may be applied to the co-ordination of Tertiary strata in various parts of the world. In 1880 I proposed a classification of the European Tertiaries, in which, apart from the special characteristic fossils of each group, stress was laid on the gradual approximation of various groups to the living Mammalia. The definitions are the following:—

DIVISIONS.	CHARACTERISTICS.
1. Eocene, or that in which the higher Mammalia (Eutheria) now on the earth were represented by allied forms belonging to existing orders and families.	Extinct orders. Living orders and families. No living genera.
Oligocene.	
2. Meiocene, in which the alliance between fossil and living Mammals is closer than before.	Living genera. No living species.
3. Pleiocene, in which living species of Mammals appear.	Living species few. Extinct species predominant.
4. Pleistocene, in which living species of Mammals preponderate.	Living species abundant. Extinct species present. Man present.
5. Prehistoric, or that period outside history in which Man has multiplied exceedingly on the earth and introduced the domestic animals.	Man abundant. Domestic animals present. Wild Mammals in retreat. One extinct Mammal.
6. Historic, in which the events are recorded in history.	Records.

These definitions are of more than European significance. The researches of Leidy, Marsh, and Cope prove that they apply equally to the Tertiary strata of North America.

It may be objected to the Prehistoric and Historic divisions of the Tertiary period that neither the one nor the other properly fall within the domain of geology. It will, however, be found that in tracing the fauna and flora from the Eocene downwards to the present day there is no break which renders it possible to stop short at the close of the Pleistocene. The living plants and animals were in existence in the Pleistocene age in every part of the world which has been investigated. The European mollusca were in Europe in the Pleiocene age. The only difference between the Pleistocene fauna, on the one hand, and the Prehistoric, on the other, consists in the extinction of certain of the mammalia at the close of the Pleistocene age in the Old and New Worlds, and in Australia. The Prehistoric fauna in Europe is also characterised by the introduction of the ancestors of the present domestic animals, some of which, such as the Celtic shorthorn *(Bos longifrons)*, sheep, goat, and domestic hog, reverted to a feral condition, and have left their remains in caves, alluvia and peat-bogs over the whole of the British Isles and the Continent. These remains, along with those of man in the neolithic, bronze, and iron stages of culture, mark off the Prehistoric from the Pleistocene strata. There is surely no reason why a cave used by palæolithic man should be handed over to the geologist, while that used by men in the Prehistoric age should be taken out of his province, or why he should be asked to study the lower strata only in a given section, and leave the upper to be dealt with by the archæologist. In these cases the ground is common to geology and archæology, and the same things, if they are looked at from the standpoint of the history of the earth, belong to the first, and, if from the standpoint of the history of man, to the second.

If, however, there be no break of continuity in the series of events from the Pleistocene to the Prehistoric ages, still less is there in those which connect the Prehistoric with the period embraced by history. The historic date of a cave or of a bed of alluvium is as clearly indicated by the occurrence of a coin as the geological position of a stratum is defined by an appeal to a characteristic fossil. The gradual unfolding of the present order of things from what went before compels me to recognise the fact that the Tertiary period extends down to the present day. The Historic period is being recorded in the strata now being formed, exactly in the same way as the other divisions of the Tertiary have left their mark in the crust of the earth, and history is incomplete without an appeal to the geological record. In the masterly outline of the destruction of Roman civilisation in Britain the historian of the English Conquest was obliged to use the evidence, obtained from the upper strata, in caves which had been used by refugees from the cities and villas; and among the materials for the future history of this city there are, to my mind, none more striking than the proof, offered by the silt in the great Roman bath, that the resort of crowds had become so utterly desolate and lonely in the ages following the English Conquest as to allow of the nesting of the wild duck.

I turn now to the place of man in the geological record, a question which has advanced but little since the year 1864. Then, as now, his relation to the glacial strata in Britain was in dispute. It must be confessed that the question is still without a satisfactory answer, and that it may well be put to "a suspense account." We may, however, console ourselves with the reflection that the river-drift man appears in the Pleistocene strata of England, France, Spain, Italy, Greece, Algiers, Egypt, Palestine, and India along with Pleistocene animals, some of which were pre-glacial in Britain. He is also proved to have been post-glacial in Britain, and was probably living in happy, sunny, southern regions, where there was no ice, and therefore no glacial period, throughout the Pleistocene age.

It may further be remarked that man appears in the geological record where he might be expected to appear. In the Eocene the Primates were represented by various Lemuroids (*Adapis*, *Necrolemur*, and others) in the Old and New Worlds. In the Meiocene the Simiadæ (*Dryopithecus*, *Pliopithecus*, *Oreopithecus*) appear in Europe, while man himself appears, along with the living species of Mammalia, in the Pleistocene age, both in Europe and in India.

The question of the antiquity of Man is inseparably connected with the further question, "Is it possible to measure the lapse of geological time in years?" Various attempts have been made, and all, as it seems to me, have ended in failure. Till we know the rate of causation in the past, and until we can be sure that it has been invariable and uninterrupted, I cannot see anything but failure in the future. Neither the rate of the erosion of the land by sub-aërial agencies, nor its destruction by oceanic currents, nor the rate of the deposit of stalagmite, or of the movement of the glaciers have as yet given us anything at all approaching a satisfactory date. We only have a sequence of events recorded in the rocks, with intervals the length of which we cannot measure. We do not know the exact duration of any one geological event. Till we know both, it is surely impossible to fix a date, in terms of years, either for the first appearance of Man, or for any event outside the written record. We may draw cheques upon "the bank of force" as well as "on the bank of time."

Two of my predecessors in this chair, Dr. Woodward and Professor Judd, have dealt with the position of our science in relation to biology and mineralogy. Professor Phillips in 1864 pointed out that the later ages in geology and the earlier ages of mankind were fairly united together in one large field of inquiry. In these remarks I have set myself the task of examining that side of our science which looks towards history. My conception of the aim and results of geology is that it should present a universal history of the various phases through which the earth and its inhabitants have passed in the various periods, until ultimately the story of the earth, and how it came to be what it is, is merged in the story of man and his works in the written records. Whatever the future of geology may be, it certainly does not seem likely to suffer in the struggle for existence in the scientific renascence of the nineteenth century.

ABSTRACT OF THE ADDRESS TO THE BIOLOGICAL SECTION OF THE BRITISH ASSOCIATION,

By W. T. Thiselton-Dyer, C.M.G., M.A., B Sc., F.R.S, F.L.S., President of the Section.

As the head of one of the great national establishments of the country devoted to the cultivation of systematic botany, I need hardly apologise for devoting a few words to the present position of that branch of the science. Of its fundamental importance I have myself no matter of doubt. But as my judgment may seem in such a matter not wholly free from bias, I may fortify myself with an opinion which can hardly be minimised in that way. The distinguished chemist Professor Lothar Meyer, perhaps the most brilliant worker in the field of theoretical chemistry, finds himself, like the systematic botanist, obliged to defend the position of descriptive science. And he draws his strongest argument from biology. "The physiology of plants and animals," he tells us, "requires systematic botany and zoology, together with the anatomy of the two kingdoms: each speculative science requires a rich and well-ordered material, if it is not to lose itself in empty and fruitless fantasies."

At present the outlook for systematic botany is somewhat discouraging. France, Germany, and Austria no longer possess anything like a school in the subject, though they still supply able and distinguished workers. That these are, however, few, may be judged from the fact that it is difficult to fill the place of the lamented Eichler in the direction of the Botanic Garden and Herbarium at Berlin. Outside our own country, Switzerland is the most important seat of general systematic study, to which three generations of De Candolles have devoted themselves. The most active centres of work at the moment are, however, to be found in our own country, in the United States, and in Russia. And the reason is, in each case, no doubt the same. The enormous area of the earth's surface over which each country holds sway brings to them a vast amount of material which peremptorily demands discussion.

No country, however, affords such admirable facilities for work in systematic botany as are now to be found in London. The Linnean Society possesses the Herbarium of Linnæus; the Botanical Department of the British Museum is rich in the collections of the older botanists; while at Kew we have a constantly increasing assemblage of material, either the results of travel and expeditions or the contributions of correspondents in different parts of the empire. A very large proportion of this has been worked up. But I am painfully impressed with the fact that the total of our available workers bears but a small proportion to the labour ready to their hands.

This is the more a matter of concern because for the few official posts which are open to botanists at home or abroad a practical knowledge of systematic botany is really indispensable. For suitable candidates for these one naturally looks to the Universities. And so far, I am sorry to say, in great measure one looks in vain. It would be, no doubt, a great impulse to what is undoubtedly an important branch of national scientific work if fellowships could occasionally be given to men who showed some aptitude for it. But these should not be mere prizes for undergraduate study, but should exact some guarantee that during the tenure of the fellowship the holder would seriously devote himself to some definite piece of work. At present, undoubtedly, the younger generation of botanists show a disposition to turn aside to those fields in which more brilliant and more immediate results can be attained. Their neglect of systematic botany brings to some extent its own Nemesis. A first principle of systematic botany is that a name should denote a definite and ascertainable species of plant. But in physiological literature you will find that the importance of this is entirely overlooked. Names are employed which are either not to be found in the books or they are altogether misapplied. I call to mind the case of an English physiologist who wrote a highly ingenious paper on the movement of water in plants. He was content to refer to the plant upon which he experimented as the "bay-laurel." I ascertained that the plant he really used was the cherry-laurel. Now, the bay is truly a laurel, while the cherry-laurel is a plum. Anyone repeating his experiments would therefore be led wholly astray. But if proper precautions are taken to ascertain the accurate botanical name of a plant no botanist throughout the civilised world is at a loss to identify it.

But precision in nomenclature is only the necessary apparatus of the subject. The data of systematic botany, when properly dis-discussed, lend themselves to very important generalisations. Perhaps those which are yielded by the study of geographical distribution are of the most general interest. The mantle of vegetation which covers the surface of the earth, if only we could rightly unravel its texture, would tell us a good deal about geological history. The study of geographical distribution, rightly handled, affords an independent line of attack upon the problem of the past distribution of land and sea. It would probably never afford sufficient data for a complete independent solution of the problem; but it must always be extremely useful as a check upon other methods. Here, however, we are embarrassed by the enormous amount of work which has yet to be accomplished. And unfortunately this is not of a kind which can be indefinitely postponed. The old terrestrial order is fast passing away before our eyes. Everywhere the primitive vegetation is disappearing as more and more of the earth's surface is brought into cultivation or, at any rate, denuded of its forests.

A good deal, however, has been done. We owe to the indomitable industry of Mr. Bentham and of Sir Ferdinand Mueller a comprehensive flora of Australia, the first large area of the earth's surface of which the vegetation has been completely worked out. Sir Joseph Hooker, in his retirement, has pushed on within sight of completion the enormous work of describing so much of the vast Indo-Malayan flora as is comprised within British possessions. To the Dutch botanists we owe a tolerably complete account of the Malayan flora proper. But New Guinea still remains botanically a *terra incognita*, and till within the last year or two the flora of China has been an absolute blank to us. A committee of the British Association (whose report will be presented to you) has, with the aid of a small grant of money, taken in hand the task of gathering up the scanty data which are available in herbaria and elsewhere. This has stimulated European residents in China to collect more material, and the fine collections which are now being rapidly poured in upon us will, if they do not overwhelm us by their very magnitude, go a long way in supplying data for a tentative discussion of the relations of the Chinese flora to that of the rest of Asia. I do not doubt that this will in turn explain a good deal that is anomalous in the distribution of plants in India. The work of the committee has been practically limited to Central and Eastern China. From the west, in Yunnan, the French botanists have received even more surprising collections, and these supplement our own work in the most fortunate manner. I have only to add for Asia Boissier's "Flora Orientalis," which practically includes the Mediterranean basin. But I must not omit the invaluable report of Brigade-Surgeon Aitchison on the collections made by him during the Afghan Delimitation Expedition. This has given an important insight into the vegetation of a region which had never previously been adequately examined. Nor must I forget the recent publication of the masterly report by Professor Bayley Balfour on the plants collected by himself and Schweinfurth in Socotra, an island with which the ancient Egyptians traded, but the singularly anomalous flora of which was almost wholly unknown up to our time.

The flora of Africa has been at present but imperfectly worked up, but the materials have been so far discussed as to afford a tolerably correct theory of its relations. The harvest from Mr. Johnston's expedition to Kilmanjaro was not as rich as might have been hoped. Still, it was sufficient to confirm the conclusions at which Sir Joseph Hooker had arrived on very slender data, as to the relations of the high-level vegetation of Africa generally. The flora of Madagascar is perhaps, at the moment, the most interesting problem which Africa presents to the botanist. As the rich collections for which we are indebted to Mr. Baron and others, are gradually worked out it can hardly be doubted that it will be necessary to modify in some respects the views which are generally received as to the relation of the island to the African continent, My colleague Mr. Baker communicated to the York meeting of the Association the results which, up to that time, he had arrived at, and these subsequent materials had not led him to modify. The flora as a whole presents a large proportion of endemic genera and species, pointing to isolation from a very ancient date. The tropical element is, however, closely allied to that of Tropical Africa and of the Mascarene Islands, and there is a small infusion of Asiatic types which do not extend to Africa. The high-level flora, on the other hand, exhibits an even closer affinity with that temperate flora the ruins of which are scattered over the mountainous regions of Central Africa, and which survives in its greatest concentration at the Cape.

The American botanists at Harvard are still systematically carrying on the work of Torrey and Gray in the elaboration of the flora of Northern America. The Russians are, on their part, continually adding to our knowledge of the flora of Northern and Central Asia. The whole flora of the North Temperate Zone can only be regarded substantially as one. The identity diminishes southwards, and increases in the case of the Arctic and Alpine regions. A collection of plants brought us from high levels in Corea by Mr. James might, as regards a large proportion of the species, have been gathered on one of our own Scotch hills.

We owe to the munificence of two English men of science the organisation of an extensive examination of the flora and fauna of Central America and the publication of the results. The work, when completed, can hardly be less expensive than that of the results of the *Challenger* voyage, which has severely taxed the liberality of the English Government. The problems which geographical distribution in this region present will doubtless be found to be of a singularly complicated nature, and it is impossible to over-estimate the debt of gratitude which biologists of all countries must owe to Messrs. Godman and Salvin, when their arduous undertaking is completed. I am happy to say that the botanical portion, which has been elaborated at Kew, is all but finished.

In South America I must content myself with referring to the great "Flora Brasiliensis," commenced by Martius half a century ago, and still slowly progressing under the editorship of Professor Urban at Berlin. Little discussion has yet been attempted of the mass of material which is enshrined in the mighty array of volumes already published. But the travels of Mr. Ball in South America have led him to the detection of some very interesting problems. The enormous pluvial denudation of the ancient portions of the continent has led to the gradual blending of the flora of different levels with sufficient slowness to permit of adaptive changes in the process. The tropical flora of Brazil, therefore, presents an admixture of modified temperate types which gives to the whole a peculiar character not met with to the same degree in the tropics of the old world. On the other hand, the comparatively recent elevation of the southern portion of the continent accounts, in Mr. Ball's eyes, for the singular poverty of its flora, which we may regard, indeed, as still in progress of development.

The botany of the *Challenger* expedition, which was also elaborated at Kew, brought for the first time into one view all the available facts as to the floras of the older oceanic islands. To this was added a discussion of the origin of the more recent floras of the islands of the Western Pacific, based upon material carefully collected by Professor Moseley, and supplemented by the notes and specimens accumulated with much judgment by Dr. Guppy. For the first time we were enabled to get some idea how a tropical island was furnished with plants, and to discriminate the littoral element due to the action of oceanic currents from the interior forest almost wholly due to frugivorous birds. The recent examination of Christmas Island by the English Admiralty has shown the process of island flora-making in another stage. The plants collected by Mr. Lister prove, as might be expected, to be closely allied to those of Java. But the effect of isolation has begun to tell; and I learn from my colleague Professor Oliver that the plants from Christmas Island cannot be for the most part exactly matched with their congeners from Java, but yet do not differ sufficiently to be specifically distinguished. We have here, therefore, it appears to me, a manifest case of nascent species.

The central problem of systematic botany I have not as yet touched upon: this is to perfect a natural classification. Such a classification, to be perfect, must be the ultimate generalisation of every scrap of knowledge which we can bring to bear upon the study of plant affinity. In the higher plants experience has shown that we can obtain results which are sufficiently accurate for the present, without carrying our structural analysis very far. Yet even here the correct relations of the Gymnosperms would never have been ascertained without patient and minute microscopic study of the reproductive processes. Upon these, indeed, the correct classification of the Vascular Cryptogams wholly depends, and generally, as we descend in the scale, external morphology becomes more and more insecure as a guide, and a thorough knowledge of the minute structure and life history of each organism becomes indispensable to anything like a correct determination of its taxonomic position. The marvellous theory of the true nature of Lichens would never have been ascertained by the ordinary methods of examination which were held to be sufficient by lichenologists.

The final form of every natural classification—for I have no doubt that the general principles I have laid down are equally true in the field of zoology—must be to approximate to the order of descent. For the Theory of Descent became an irresistible induction as soon as the idea of a natural classification had been firmly grasped.

Interesting as are the problems which the structure, the functions, the affinity, or the geographical distribution of a plant may afford, the living plant in itself is even more interesting still. Every organ will bear interrogation to trace the meaning and origin of its form and the part it plays in the plant's economy. That there is here an immense field for investigation there can be no doubt Mr. Darwin himself set us the example in a series of masterly investigations. But the field is well-nigh inexhaustible. The extraordinary variety of form which plants exhibit has led to the notion that much of it may have arisen from indifferent variation. No doubt, as Mr. Darwin has pointed out, when one of a group of structures held together by some morphological or physiological *nexus* varies, the rest will vary correlatively. One variation then may, if advantageous, become adaptive, while the rest will be indifferent. But it appears to me that such a principle should be applied with the greatest caution, and from what I have myself heard fall from Mr. Darwin, I am led to believe that in the later years of his life he was disposed to think that every detail of plant structure had some adaptive significance, if only the clue could be found to it. As regards the forms of flowers an enormous body of information has been collected, but the vegetative organs have not yielded their secret to anything like the same extent. My own impression is that they will be found to be adaptive in innumerable ways which at present are not even suspected. At Kew we have probably a larger number of species assembled together than are to be found anywhere on the earth's surface. Here, then, is ample material for observation and comparison. But the adaptive significance will doubtless often be found by no means to lie on the surface. Who, for example, could possibly have guessed by inspection the purpose of the glandular bodies on the leaves of *Acacia sphærocephala* and on the pulvinus of *Cecropia peltata* which Belt in the one case and Fritz Müller in the other have shown to serve as food for ants? So far from this explanation being far-fetched, Belt found that the former "tree is actually unable to exist without its guard," which it could not secure without some attraction in the shape of food. One fact which strongly impresses me with a belief in the adaptive significance of vegetative characters is the fact that in almost identical forms they are constantly adopted by plants of widely different affinity. If the forms were without significance one would expect them to be infinitely varied. If, however, they are not so, it is intelligible that different plants should independently avail themselves of the same appliances and expedients.

Although this country is splendidly equipped with appliances for the study of systematic botany, our Universities and colleges fall far behind a standard which would be considered even tolerable on the Continent in the means of studying morphological and physiological botany or of making researches in these subjects. There is not at the moment anywhere in London an adequate botanical laboratory; and though at most of the Universities matters are not quite so bad, still I am not aware of any one where it is possible to do more than give the routine instruction or to allow the students, when they have passed through this, to work for themselves. It is not easy to see why this should be, because on the animal side the accommodation and appliances for teaching comparative anatomy and physiology are always adequate and often palatial. Still less explicable to me is the tendency on the part of those who have charge of medical education to eliminate botanical study from the medical curriculum, since historically the animal histologists owe everything to botanists. In the seventeenth century Hooke first brought the microscope to the investigation of organic structure, and the tissue he examined was cork. Somewhat later Grew, in his "Anatomy of Plants," gave the first germ of the cell theory. During the eighteenth century the anatomists were not merely on a hopelessly wrong tack themselves, but they were bent on dragging botanists into it also. It was not till 1837, a little more than fifty years ago, that Henle saw that the structure of epithelium was practically the same as that of the *Parenchyma plantarum* which Grew had described 150 years before. Two years later Schwann published his immortal theory, which comprised the ultimate facts of plant and animal anatomy under one view. But it was to a botanist, Von Mohl, that, in 1846, the biological world owed the first clear description of protoplasm, and to another botanist, Cohn (1851), the identification of this with the sarcode of zoologists.

Now the historic order in discovery is not without its significance. The path which the first investigators found most accessible is doubtless that which beginners will also find easiest to tread. I do not myself believe that any better access can be obtained to the structure and functions of living tissues than by the study of plants. However, I am not without hopes that the serious study of botany in the laboratory will be in time better cared for. I do not hesitate to claim for it a position of the greatest importance in ordinary scientific education. All the essential phenomena of living organisms can be readily demonstrated upon plants. The necessary appliances are not so costly, and the work of the class-room is free from many difficulties with which the student of the animal side of biology has to contend.

Those, however, who have seriously devoted themselves to the pursuit of either morphological or physiological botany need not now be wholly at a loss. The splendid laboratory on Plymouth Sound, the erection of which we owe to the energy and enthusiasm of Professor Ray Lankester, is open to botanists as well as to zoologists, and affords every opportunity for the investigation of marine plants, in which little of late years has been done in this country. At Kew we owe to private munificence a commodious laboratory, in which much excellent work has already been done. And this Association has made a small grant in aid of the establishment of a laboratory in the Royal Botanic Garden at Peradeniya, in Ceylon. It may be hoped that this will afford facilities for work of the same kind as has yielded Dr. Treub such a rich harvest of results in the Buitenzorg Botanic Garden, in Java.

Physiological botany, as I have already pointed out, is a field in which this country in the past has accomplished great things. It has not of late, however, obtained an amount of attention in any way proportionate to that devoted to animal physiology. In the interests of physiological science generally this is much to be deplored; and I believe that no one was more firmly convinced of this than Mr. Darwin. Only a short time before his death, in writing to Mr. Romanes on a book that he had recently been reading, he said that the author had made "a gigantic oversight in never considering plants; these would simplify the problem for him." This goes to the root of the matter. There is, in my judgment, no fundamental biological problem which is not exhibited in a simpler form by plants than animals. It is possible, however, that the distaste which seems to exist amongst our biologists for physiological botany may be due in some measure to the extremely physical point of view from which it has been customary to treat it on the Continent. It is owing in great measure to the method of Mr. Darwin's own admirable researches that in this country we have been led to a more excellent way. The work which has been lately done in England seems to me full of the highest promise. Mr. Francis Darwin and Mr. Gardiner have each in different directions shown the entirely new point of view which may be obtained by treating plant phenomena as the outcome of the functional activity of protoplasm. I have not the least doubt that by pursuing this path English research will not merely place vegetable physiology, which has hitherto been too much under the influence of Lamarckism, on a more rational basis, but that it will also sensibly react, as it has done often before, on animal physiology.

There is no part of the field of physiological botany which has yielded results of more interest and importance than that which relates to the action of ferments and fermentation; and I could hardly give you a better illustration of the purely biological method of treating it. I believe that these results, wonderful and fascinating as they are, afford but a faint indication of the range of those that are still to be accomplished. The subject is one of extreme intricacy, and it is not easy to speak about it briefly. To begin with, it embodies two distinct groups of phenomena which have in reality very little which is essential in common.

What are usually called ferments are perhaps the most remarkable of all chemical bodies, for they have the power of effecting very profound changes in the chemical constitution of other substances, although they may be present in very minute quantity; but, which is their most singular and characteristic property, they themselves remain unchanged in the process. It may be said without hesitation that the whole nutrition of both animals and plants depends on the action of ferments. The organism is incapable of using solid nutrient matter for the repair and extension of its tissues; it must be first brought into a soluble form before it can be made available, and this change is generally brought about by the action of a ferment. Animal physiology has long been familiar with the part played by these bodies, and it may be said that no small part of the animal economy is made up of organs required either for the manufacture of ferments or for the exposure of ingested food to their action. It may seem strange at first sight to speak of analogous processes taking place in plants, but it must be remembered that plant nutrition includes two very distinct stages. Certain parts of plants build up, as every one knows, from external inorganic materials substances which are available for the construction of new tissues. It might be supposed that these are used up as fast as they are formed. But it is not so; the life of the plant is not a continuous balance of income and expenditure. On the contrary, besides the general maintenance of its structure, the plant has to provide from time to time for enormous resources to meet such exhausting demands as the renewal of foliage, the production of flowers, and the subsequent maturing of fruit.

In such cases the plant has to draw on an accumulated store of solid food, which has rapidly to be converted into the soluble form in which alone it is competent to be drawn off through the tissues to the seat of consumption. And I do not doubt, for my part, that in such cases ferments are brought into play of the same kind and in the same way as in the animal economy. Take such a simple case as a potato tuber. This is a mass of cellular tissue, the cells of which are loaded with starch. We may either dig up the tuber and eat the starch ourselves or we may leave it in the ground, in which case it will be consumed in providing material for the growth of a potato-plant next year. But the processes by which the insoluble starch is made available for nutrition are, I cannot doubt, closely similar in either case.

When we inquire further about these mysterious and all-important bodies the answer we can give is extremely inadequate. It is very difficult to obtain them in amount sufficient for analysis or in a state of purity. We know, however, that they are closely allied to albuminoids, and contain nitrogen in varying proportion. Papain, which is a vegetable ferment derived from the fruit of the papaw, and capable of digesting most animal albuminoids, is said to have the same ultimate composition as the pancreatic ferment and of peptones, bodies closely allied to proteids; the properties of all three bodies are, however, very different. It seems clear, nevertheless, that ferments must be closely allied to proteids, and like these bodies, they are no doubt directly derived from protoplasm.

I need not remind you that, unlike other constituents of plant tissues, protoplasm, as a condition of its vitality, is in a constant state of molecular activity. The maintenance of this activity involves the supply of energy, and this is partly derived from the waste of its own substance. This "self-decomposition" of the protoplasm liberates energy, and in doing so gives rise to a number of more stable bodies than protoplasm. Some of these are used up again in nutrition; others are thrown aside and are never drawn again into the inner circle of vital processes. In the animal organism, where the strictest economy of bulk is a paramount necessity, they are promptly got rid of by the process of excretion. In the vegetable economy these residual products usually remain. And it is for this reason, I may point out, that the study of the chemistry of plant nutrition appears to me of such immense importance. The record of chemical change is so much more carefully preserved, and the probability of our being able to trace the changes it has followed is consequently far more likely to be attended with success.

This preservation in the plant of the residual by-products of protoplasmic activity no doubt accounts for the circumstance which otherwise is extremely perplexing—the profusion of substances which we meet with in the vegetable kingdom to which it is hard to attribute any useful significance. It seems probable that ferments in a great many cases belong to the same category. I imagine that it is in some degree accidental that some of them have been made use of, and thus the plant has been able to temporarily lock up accumulations of food, to be drawn upon in future phases of its life with the certainty that they would be available. Without the ferments the key of the storehouse would be lost irretrievably.

Plants, moreover, are now known to possess ferments, and the number will doubtless increase to which it is difficult to attribute any useful function. Papain, to which I have already alluded, abounds in the papaw, but it is not easy to assign to it any definite function; still less is it easy, on teleological grounds, to account for the rennet ferment contained in the fruits of an Indian plant, *Withania coagulans*, and admirably investigated by Mr. Sheridan Lea.

Having dwelt so far on the action of ferments, we may now turn to fermentation and that other kind of change in organic matter called "putrefaction," which is known to be closely allied to fermentation. Ferments and fermentation, as I have already remarked, have very little to do with one another; and it would save confusion and emphasise the fact if we ceased to speak of ferments, but used some of the alternative names which have been proposed for them, such as *zymases* or *enzymes*.

The classical case of fermentation, which is the root of our whole knowledge of the subject, is that of the conversion of sugar into alcohol. Its discovery has everywhere accompanied the first stages of civilisation in the human race. Its details are now taught in our text-books; and I should hardly hope to be excused for referring to it in any detail if it were not necessary for my purpose to draw your attention more particularly to one or two points connected with it.

Let us trace what happens in a fermenting liquid. It becomes turbid; it froths and effervesces; the temperature sensibly increases; this is the first stage. After this it begins to clear; the turbidity subsides as a sediment; the sugar which the fluid at first contained has in great part disappeared, and a new ingredient, alcohol, is found in its place.

It is just fifty years ago that the great Dutch biologist Schwann made a series of investigations which incontrovertibly demonstrated that both fermentation and putrefaction were due to the presence of minute organisms which live and propagate at the expense of the liquids in which they produce as a result these extraordinary changes. The labours of Pasteur have confirmed Schwann's results, and—what could not have been foreseen—have extended the possibilities of this field of investigation to those disturbances in the vital phenomena of living organisms themselves which we include under the name of "disease," and which, no one will dispute, are matters of the deepest concern to every one of us.

Now, at first sight, the conversion of starch into sugar by means of diastase seems strikingly analogous to the conversion of sugar into alcohol. It is for this reason that the phenomena have been so long associated. But it is easy to show that they are strikingly different. Diastase is a chemical substance of obscure composition, it is true, but inert and destitute of any vital properties, nor is it affected by the changes it induces. Yeast, on the other hand, which is the active agent in alcoholic fermentation, is a definite organism; it enormously increases during the process, and it appears to me impossible to resist the conclusion that fermentation is a necessary concomitant of the peculiar conditions of its life. Let me give you a few facts which go to prove this. In the first place, you cannot ferment a perfectly pure solution of sugar. The fermentible fluid must contain saline and nitrogenous matters necessary for the nutrition of the yeast protoplasm. In pure sugar the yeast starves. Next, Schwann found that known protoplasmic poisons, by killing the yeast-cells, would prohibit fermentation. He found the same result to hold good of putrefaction, and this is the basis of the whole theory of antiseptics. Nor can the action of yeast be attributed to any ferment which the yeast secretes. It is true that pure cane-sugar cannot be fermented, and that yeast effects the inversion of this, as it is called, into glucose and lævulose. It does this by a ferment which can be extracted from it, and which is often present in plants. But you can extract nothing from yeast which will do its peculiar work apart from itself. Helmholtz made the crucial experiment of suspending a bladder full of boiled grape-juice in a vat of fermenting must: it underwent no change; and even a film of blotting-paper has been found a sufficient obstacle to its action. We are driven, then, necessarily to the conclusion that in the action of "ferments," or zymases, we have to do with a chemical—*i.e.*, a purely physical process; while in the case of yeast we encounter a purely physiological one.

How, then, is this action to be explained? Pasteur has laid stress on a fact which had some time been known, that the production of alcohol from sugar is a result of which yeast has not the monopoly. If ripening fruits, such as plums, are kept in an atmosphere free from oxygen, Bérard found that they, too, exhibit this remarkable transformation; their sugar is converted appreciably into alcohol. On the other hand, Pasteur has shown that if yeast is abundantly supplied with oxygen it feeds on the sugar of a fermentible fluid without producing alcohol. But under the ordinary circumstances of fermentation its access to oxygen is practically cut off; the yeast, then, is in exactly the same predicament as the fruit in Bérard's experiment. Sugar is broken up into carbon dioxide and alcohol in an amount far in excess of the needs of mere nutrition. In this dissociation it can be shown that an amount of energy is set free in the form of heat equal to about one-tenth of what would be produced by the total combustion of an equivalent amount of grape-sugar. If the protoplasm of the yeast could, with the aid of atmospheric oxygen, completely decompose a unit of grape-sugar, it would get ten times as much energy in the shape of heat as it could get by breaking it up into alcohol and carbon dioxide. It follows, then, that to do the same amount of growth in either case it must break up ten times as much sugar without a supply of oxygen as with it. And this throws light on what has always been one of the most remarkable facts about fermentation—the enormous amount of change which the yeast manages to effect in proportion to its own development.

There are still two points about yeast which deserve attention before we dismiss it. When a fermenting liquid comes to contain about 14 per cent. of alcohol the activity of the yeast ceases, quite independently of whether the sugar is used up or not. In other cases of fermentation the same inhibiting effect of the products of fermentation is met with. Thus lactic fermentation soon comes to an end unless calcium carbonate or some similar substance be added, which removes the lactic acid from the solution as fast as it is formed.

The other point is that in all fermentations, besides what may be termed the primary products of the process, other bodies are produced. In the case of alcoholic fermentation the primary bodies are alcohol and carbon dioxide, the secondary succinic acid and glycerine. Delpino has suggested that these last are residual products derived from that portion of the fermentible matter which is directly applied to the nutrition of the protoplasm.

Yeast, itself the organism which effects the remarkable changes on which I have dwelt, is somewhat of a problem. It is clear that it is a fungus, the germs of which must be ubiquitous in the atmosphere. It is difficult to believe that the simple facts which are all we know about it constitute its entire life history. It is probably a transitory stage of some more complicated organism.

I can only briefly refer to putrefaction. This is a far more complex process than that which I have traced in the case of alcoholic fermentation. In that nitrogen is absent, while it is an essential ingredient in albuminoids, which are the substances which undergo putrefactive changes. But the general principles are the same. Here, too, we owe to Schwann the demonstration of the fact that the effective agents in the process are living organisms. If we put into a flask a putrescible liquid such as broth, boil it for some time, and during the process of boiling plug the mouth with some cotton wool, we know that the broth will remain long unchanged, while if we remove the wool putrescence soon begins. Tyndall has shown that if we conduct the experiment on one of the high glaciers of the Alps the cotton wool may be dispensed with. We may infer, then, that the germs of the organisms which produce putrefaction are abundant in the lower levels of the atmosphere, and are absent from the higher. They are wafted about by currents of air; but they are not imponderable, and in still air they gradually subside. Dr. Lodge has shown that air is rapidly cleared of suspended dust by an electric discharge, and this, no doubt, affords a simple explanation of the popular belief that thunderous weather is favourable to putrefactive changes.

Cohn believes that putrefaction is due to an organism called *Bacterium termo*, which plays in it the same part that yeast does in fermentation. This is probably too simple a statement, but the general phenomena are nevertheless similar. There is the same breaking down of complex into simpler molecules; the same evolution of gas, especially carbon dioxide; the same rise of temperature. The more or less stable products of the process are infinitely more varied, and it is difficult, if not impossible, to say, in the present state of our knowledge, whether in most cases they are the direct outcome of the putrefactive process or residual products of the protoplasmic activity of the organisms which induce it. Perhaps, on the analogy of the higher plants, in which some of them also occur, we may attribute to the latter category certain bodies closely resembling vegetable alkaloids; these are called ptomains, and are extremely poisonous. Besides such bodies, Bacteria undoubtedly generate true ferments and peculiar colouring matters. But there is in most cases of putrefaction a profusion of other substances, which represent the various stages of the breaking up of the complex proteid molecule, and are often themselves the outcome of subsidiary fermentations.

These results are of great interest from a scientific point of view. But their importance at the present moment in the study of certain kinds of disease can hardly be exaggerated. I have already mentioned Henle as having first found the true clue to animal histology in the structure of plants. As early as 1840 the same observer indicated the argument for regarding contagious diseases as due to living organisms. I will state his argument in the words of De Bary, whose "Lectures on Bacteria," the last work which we owe to his gifted hand, I can confidently recommend to you as a luminous but critical discussion of a vast mass of difficult and conflicting literature.

It was, of course, clear that contagion must be due to the communication of infectious particles or contagia. These contagia, although at the time no one had seen them, Henle pointed out, "have the power, possessed, as far as we know, by living creatures only, of growing under favourable conditions, and of multiplying at the expense of some other substance than their own, and therefore of assimilating that substance." Henle enforced his view by comparison with the theory of fermentation which had then been promulgated by Schwann. But for many years his views found no favour. Botanists, however, as in so many other cases, struck on the right path, and from about the year 1850 steady progress, in which De Bary himself took a leading part, was made in showing that most of the diseases of plants are due to parasitic infection. The reason of this success was obvious: the structure of plants make them more accessible to research, and the invading parasites are larger than animal contagia. On the animal side all real progress dates from about 1860, when Pasteur, having established Schwann's theory of fermentation on an impregnable basis, took up Henle's theory of living contagia.

The only risk now is that we may get on too fast. To put the true theory of any one contagious disease on as firm a basis as that of alcoholic fermentation is no easy matter to accomplish. But I believe that this is, notwithstanding a flood of facile speculation and imperfect research, slowly being done.

There are two tracts in the body which are obviously accessible to such minute organisms as bacteria, and favourable for their development. These are the alimentary canal and the blood. In case of the former there is evidence that every one of us possesses quite a little flora of varied forms and species. They seem for the most part, in health, to be comparatively innocuous; indeed, it is believed that they are ancillary to and aid digestion. But it is easy to see that other kinds may be introduced, or those already present may be called into abnormal activity, and fermentative processes may be set up of a very inconvenient kind. These may result in mere digestive disorder or in the production of some of those poisonous derivatives of proteids of which I have spoken, the effect of which upon the organism of the part may be most disastrous.

The access of bacteria to the blood is a far more serious matter. They produce phenomena the obvious analogy of which to fermentative processes has led to the resulting diseases being called zymotic. Take, for example, the disease known as "relapsing fever." This is contagious. After a period of incubation violent fever sets in, which lasts for something less than a week, is then followed by a period of absence, to be again followed in succession by one or more similar attacks, which ultimately cease. Now you will observe that the analogy to a fermentative process is very close. The period of incubation is the necessary interval between the introduction of the germ and its vegetative multiplication in sufficient numbers to appreciably affect the total volume of the blood. The rise in temperature and the limited duration of the attack are equally, as we have seen, characteristic of fermentative processes, while the bodily exhaustion which always follows fever is the obvious result of the dissipation by the ferment organisms of nutritive matter destined for the repair of tissue waste. During the presence of this fever there is present in the blood an organism, *Spirochæte Obermeieri*, so named after its discoverer. This disappears when the fever subsides. It is found that if other individuals are inoculated with blood taken from patients during the fever attack the disease is communicated, but that this is not the case if the inoculation is made during the period of freedom. The evidence then seems clear that this disease is due to a definite organism. The interesting point, however, arises, why does the fever recur? and why eventually cease? The analogy of fermentation leads to the hypothesis that, as in the case of yeast, the products of its action inhibit after a time the further activity of the *Spirochæte*. The inhibiting substance is, no doubt, eventually removed partially from the blood by its normal processes of depuration, and the surviving individuals of *Spirochæte* can then continue their activity, as in lactic fermentation. With regard to the final cessation of the disease, there are facts which may lead one to suppose that in this, as in other cases, sufficient of the inhibiting substance ultimately remains in the organism to protect it against any further outbreak of activity on the part of the *Spirochæte*.

Here we have an example of a disease which, though having a well-marked zymotic character, is comparatively harmless. In anthrax, which is known to be due to *Bacillus subtilis*, we have one which is, on the contrary, extremely fatal. I need not enter into the details. It is sufficient to say that there is reason to believe that the *Bacillus* produces, as one of those by-products of protoplasmic destruction to which I have already alluded, a most virulent poison. But the remarkable thing is that this *Bacillus*, which can be cultivated externally to the body, if kept at a heightened temperature, can be attenuated in its virulence. It drops, in fact, the excretion of the poison. It is then found that if injected into the blood it does no mischief, and what is more extraordinary, if the *Bacillus* in its most lethal form is subsequently introduced it too has lost its power. The explanation of the immunity in this case is entirely different to that which was suggested by a consideration of the facts of relapsing fever. The researches of Metschnikoff have led to the hypothesis that in the present case the white-blood corpuscles destroy the *Bacillus*. When they first come into contact with these in their virulent form they are unable to touch them. But if they have been educated by first having presented to them the attenuated form they find no difficulty in grappling with the malignant. This is a very remarkable view. I should not have put it before you had there not been solid reasons for regarding the idea of the education of protoplasm with scientific respect. The plasmodia of the myxomycetes, which consist of naked protoplasm, are known to become habituated to food which they at first reject, and the researches of Beyerinck on the disease known as "gumming" in plants have apparently shown that healthy cells may be taught, as it were, to produce a ferment which otherwise they would not excrete.

If Metschnikoff's theory be true we have a rational explanation of vaccination and of preventive inoculation generally. It is probably, however, not the only explanation. And the theory of the inhibitive action upon itself of the products of the ferment-organism's own activity is still being made the basis of experiment. In fact, the most recent results point to the possibility of obtaining protection by injecting into the blood substances artificially obtained, entirely independent of the organisms whose development they inhibit.

It is impossible for me to touch on these important matters at any greater length, but I doubt if the theory of fermentation, as applied to the diseases of organisms, has as yet more than opened its first page. It seems to me possible that, besides the rational explanation of zymotic diseases, it may throw light on others where, owing to abnormal conditions, the organism, as in the case of Bérard's plants, is itself the agent in its own fermentative processes.

And now I must conclude. I have led you, I am afraid, a too lengthy and varied a journey in the field of botanical study. But to sum up my argument: I believe I have shown you that at the bottom of every great branch of biological inquiry it has never been possible to neglect the study of plants; nay, more, that the study of plant-life has generally given the key to the true course of investigation. Whether you take the problems of geographical distribution, the most obscure points in the theory of organic evolution, or the innermost secrets of vital phenomena, whether in health or disease, not to consider plants is still, in the words of Mr. Darwin, "a gigantic oversight, for these would simplify the problem."

ABSTRACT OF THE ADDRESS TO THE GEOGRAPHICAL SECTION OF THE BRITISH ASSOCIATION,

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The great civilisations of high antiquity appear to have risen and expanded in four riverain districts; Chinese in the basins of the Hoang Ho and the Yang-tse-Kiang; Hindu in those of the Indus and the Ganges; Chaldæan and Assyro-Babylonian in those of the Tigris and Euphrates; and Egyptian in that of the Nile. India is separated from China, on the one hand, by rugged, lofty monntain ranges, and the high-lying plateau of Thibet; and from Mesopotamia, on the other, by the Suleiman Mountains and the Perso-Afghan plateau. Intercommunication between these early seats of man's activity must, therefore, have been of slow growth. From Mesopotamia, on the contrary, there is easy access to the Nile basin by way of Syria and Palestine, and there are indications of traffic between these districts at a very remote period. Enquiry into the causes which first led to intercommunication and into the means by which it was effected is needless. Desire of gain, lust of power, were as much a part of human nature in the earliest ages as they are now. The former induced the pioneers of commerce to feel their way across trackless deserts, and to brave the hidden dangers of the sea; and for nearly three hundred years it led gallant men to seek a way to the wealth of India through the ice-laden seas of the Arctic region. The latter brought the great empires of Assyria and Egypt into hostile conflict, and carried Alexander to the banks of the Oxus and the Indus; and it is largely answerable for the land-hunger of European states in our own generation.

Nations rise, fall, and disappear, but commerce extends in ever-widening circles, and knows no limits. Efforts are constantly being made to discover and open up new fields of commercial activity and to connect the great centres of commerce by quicker and shorter trade routes. The earliest traffic was conducted by land; men travelled together in caravans for mutual protection, and rested where food and water were to be obtained; at the most important of these halting places cities were founded. As trade extended it became necessary to carry goods through independent tribes or countries which often insisted on retaining the transit trade in their own hands, and this led to the rise of cities at points convenient for the transfer of loads and the exchange of the commodities of one country for those of another. Generally speaking this early overland trade was co-extensive with the geographical limit of the camel. Next in order to land traffic came that by water, first on rivers, then on the sea; and cities naturally sprang up at places on the coast where the merchandise brought down the rivers in boats could, conveniently and safely, be transferred to galleys or ships suitable for coasting. Increased knowledge of the globe, improvements in the art of shipbuilding, and the invention of the steam-engine have gradually led to the ocean traffic of the present day, conducted by large steamers which, regardless of wind and tide, follow the most direct course from one point to another. The trade routes of the world are subject to two great modifying influences, one physical, the other political. The inland trade of India, for instance, can only reach Central Asia and the West by way of Herat or Bamian; caravan roads across the deserts of Asia and Africa must follow lines of springs or wells; climatic conditions render all Polar routes impracticable; and the removal of a physical obstacle, by the construction of the Suez Canal, is now causing a remarkable redistribution of the channels of commerce. So, too, disturbance of traffic by war, or its designed destruction by conquerors; and great political changes, such as the establishment of the Persian Empire, the rise of Rome, the disruption of the Roman Empire, and the advent of the Arabs to power in Western Asia, divert trade from its accustomed routes and force it into new channels, to the ruin of some cities and states and the enrichment of others. The general tendency of trade so diverted is to seek, where possible, a maritime route, for water transport is not only less costly but less liable to interruption than land transport.

India, partly from its geographical position, partly from the character of its people, has always played a passive rôle in commerce, and allowed the initiative in commercial enterprise to rest with the West. The greatest advantages have always been derived from the possession of the trade between the East and the West, and, from a remote period, the nations of the world have contended for this rich prize. One state after another has obtained and lost the prize; England now holds it, but if she is to keep what she has obtained there must be a far closer study than there has hitherto been, of geography and terrestrial phenomena in their relation to commerce.

Since the discovery of the Cape route there has been one long struggle for the possession of the commerce of India; who should be the carriers and distributors of Indian commodities was for more than two and a half centuries a much contested point amongst the maritime nations of the West. At first there seems to have been a general acquiescence in the claim of the Spaniards and Portuguese to a monopoly of the southern sea-routes, and this led to those heroic efforts to find a north-east or north-west passage to India which have so greatly added to our geographical knowledge. Failure in this direction was followed by attempts to reach India by the Cape in the face of the hostile attitude of Spain and Portugal. The mighty events which in turn transferred wealth and commerce from Lisbon to Antwerp, Amsterdam, and the banks of the Thames are matter of history, and it is scarcely necessary to say that at the close of the Napoleonic wars, England remained undisputed mistress of the sea, and had become not only the carrier of all ocean-borne traffic, but the distributing centre of Indian goods to the whole world. A period of keen competition for a share in the commerce of India has again commenced amongst the states of Europe, and symptoms of a coming change in the carrying and distributing trade have been increasingly apparent since Africa was separated from Asia, nearly twenty years ago, by the genius of M. de Lesseps.

The opening of the Suez Canal, by diverting trade from the Cape route to the Mediterranean, has produced and is still producing changes in the intercourse between the East and the West which affect this country more nearly, perhaps, than any other European state. The changes have been in three directions.

First. An increasing proportion of the raw material and products of the East is carried direct to Mediterranean ports, by ships passing through the Canal, instead of coming, as it once did, to England for distribution. Thus Odessa, Trieste, Venice, and Marseilles are becoming centres of distribution for Southern and Central Europe, as Antwerp and Hamburg are for the North; and our merchants are thus losing the profits they derived from transhipping and forwarding Eastern goods to Europe. It is true that the carrying trade is still, to a very great extent, in English hands; but should this country be involved in a European war the carrying trade, unless we can efficiently protect it, will pass to others, and it will not readily return. Continental manufacturers have always been heavily handicapped by the position England has held since the commencement of the century, and the distributing trade would doubtless have passed from us in process of time. The opening of the Canal has accelerated the change to the detriment of English manufactures, and consequently of the national wealth; and it must tend to make England less and less each year the emporium of the world. We are experiencing the results of a natural law that a redistribution of the centres of trade must follow a rearrangement of the channels of commerce.

Second. The diversion of traffic from the Cape route has led to the construction of steamers for special trade to India and the East through the Canal. On this line coaling stations are frequent, and the seas, excepting in the Bay of Biscay, are more tranquil than on most long voyages. The result is that an inferior type of vessel, both as regards coal-stowage, speed, endurance, and seaworthiness has been built. These "canal-wallahs," as they are sometimes called, are quite unfitted for the voyage round the Cape, and should the Canal be blocked by war or accident, they would be practically useless in carrying on our Eastern trade. Since the Canal has been deepened they have improved, for it has been found cheaper to have more coal-stowage, but they are still far from being available for the long voyage round the Cape. Had the Canal not been made, a large number of fine steamers would gradually have been built for the Cape route, and though the sailing ships which formerly carried the India and China trade would have held their own longer, we should by this time have had more of the class of steamer that would be invaluable to us in war time, and our trade would not have been liable, as it is now, to paralysis by the closing of the Canal.

Third. Sir William Hunter has pointed out that, since the opening of the Canal, India has entered the market as a competitor with the British workman; and that the development of that part of the empire as a manufacturing and food-exporting country will involve changes in English production which must for a time be attended by suffering and loss. Indian trade has advanced by rapid strides, the exports of merchandise have risen from an average of 57 millions for the five years preceding 1874 to 88 millions in 1884, and there has been an immense expansion in the export of bulky commodities. Wheat, which occupied an insignificant place in the list of exports, is now a great staple of Indian commerce, and the export has risen since 1873 from $1\frac{3}{4}$ to 21 million hundredweight. It is almost impossible to estimate the ultimate dimensions of the wheat trade, and it is only the forerunner of other trades in which India is destined to compete keenly with the English and European producers.

The position in which England has been placed by the opening of the Canal is in some respects similar to that of Venice after the discovery of the Cape route; but there is a wide difference in the spirit with which the change in the commercial routes was accepted. Venice made no attempt to use the Cape route, and did all she could to prevent others from taking advantage of it; England, though by a natural instinct she opposed the construction of the Canal, was one of the first to take advantage of it when opened, and so far as the carrying trade is concerned she has hitherto successfully competed with other countries.

The increasing practice of the present day is for each maritime country to import and carry the Indian and other commodities it requires, and we must be prepared for a time when England will no longer be the emporium of Eastern commerce for Europe, or possess so large a proportion as she now does of the carrying trade. So great, however, is the genius of the English people for commercial enterprise, and so imbued are they with the spirit of adventure, that we may reasonably hope loss of trade in one direction will be compensated by the discovery of new fields of commercial activity. The tendency at present is to shorten sea-routes by maritime canals; to construct canals for bringing ocean-going ships to inland centres of industry; and to utilise water carriage, wherever it may be practicable, in preference to carriage by land. For a correct determination of the lines which these shortened trade routes and great maritime canals should follow, a sound knowledge of geography and of the physical condition of the earth is necessary; and instruction in this direction should form an important feature in any educational course of commercial geography. The great problem of the future is the inland carrying trade, and one of the immediate commercial questions of the day is—who is to supply the interiors of the great continents of Asia and Africa, and other large areas not open to direct sea traffic?

The question of supplying European goods to one portion of Central Asia has been partially solved by the remarkable voyage of Mr. Wiggins last year, and by the formation of the company of the "Phœnix Merchant Adventurers." Mr. Wiggins started from Newcastle-on-Tyne for Yeniseisk, the first large town on the Yenesei, some 2,000 miles from the mouth of that river and within a few hundred versts of the Chinese frontier. On the 9th October, 1887, he cast anchor and landed his cargo in the heart of Siberia. The exploit is one of which any man might well be proud, but in Mr. Wiggins's case there is the additional merit that success was the result of conviction arrived at by a strict method of induction, that the Gulf Stream passed through the Straits into the Kara Sea and that its action, combined with that of the immense volume of water brought down by the Obi and Yenisei, would free the sea from ice and render it navigable for a portion of each year. The attempts of England to open up commercial relations with the interior of Africa have too often been marked by want, if not open contempt, of geographical knowledge, and by a great deficiency of foresight; but the competition with Germany is forcing this country to pay increased attention to African commerce, and the formation of such companies as the British East African Company, the African Lakes Company and the Royal Niger Company is a happy omen for the future.

I am afraid that I have frequently travelled beyond the sphere of geography. My object has been to draw attention to the supreme importance to this country of the science of commercial geography. That science is not confined to a knowledge of the localities in which those products of the earth which have a commercial value are to be found, and of the markets in which they can be sold with the greatest profit. Its higher aims are to divine, by a combination of historical retrospect and scientific foresight, the channels through which commerce will flow in the future, and the points at which new centres of trade must arise in obedience to known laws. A precise knowledge of the form, size, and geological structure of the globe; of its physical features; of the topographical distribution of its mineral and vegetable products, and of the varied forms of animal life, including man, that it sustains; of the influence of geographical environment on man and the lower animals; and of the climatic conditions of the various regions of the earth, is absolutely essential to a successful solution of the many problems before us. If England is to maintain her commanding position in the world of commerce she must approach these problems in the spirit of Prince Henry the Navigator, and by high scientific training fit her sons to play their part like men in the coming struggle for commercial supremacy. The struggle will be keen, and victory will rest with those who have most fully realised the truth of the maxim that "knowledge is power."

I may add that if there is one point clearer than another in the history of commerce it is this: that when a state cannot effectually protect its carrying trade in time of war, that trade passes from it and does not return. If England is ever found wanting in the power to defend her carrying trade, her fate will only too surely, and I might almost say justly, be that of Venice, Spain, Portugal and Holland.

In Africa the existence nearly everywhere of a wide coast plain with a deadly climate, and the difficulties attending land transport in a country where the usual beasts of burden, such as the camel, the ox, the horse, and the mule, cannot be utilised, will probably for many years retard the development of the land trade. On the other hand, the Congo with its wide-reaching arms, the Niger, the Nile, the Zambesi, the Shiré, and the great lakes Nyassa, Tanganyika, and the Victoria and Albert Nyanzas offer great facility for water transport, and afford easy access to the interior without traversing the pestilential plains. Already steamers ply on most of the great waterways—each year sees some improvement in this respect; and a road is in course of construction from Lake Nyassa to Tanganyika which will tend, if Arab raiders can be checked, to divert inland traffic from Zanzibar to Quilimane, and will become an important link in what must be one of the great trade routes in the future. It is possible, I believe, with our present knowledge of Africa, and by a careful study of its geographical features, to foresee the lines along which trade routes will develop themselves and the points at which centres of trade will arise; but I have already detained you too long, and will only venture to indicate Sawákin, Mombasa, Quilimane, or some point near the mouth of the Zambesi, and Delagoa Bay, as places on the east coast of Africa which, from their geographical position, must eventually become of great importance as outlets for the trade of the interior.

The future of Africa presents many difficult problems, some of which will no doubt be brought to your notice during the discussion which, I trust, will follow the reading of the African papers; and there is one especially—the best means of putting an end to slave-hunting and the slave-trade—which is now happily attracting considerable attention. It is surely not too much to hope that the nations which have been so eager to annex African soil will remember the trite saying that "property has its duties as well as its rights," and that one of the most pressingly important of the duties imposed upon them by their action is to control the fiends in human form who, of set purpose, have laid waste some of the fairest regions of the earth, and imposed a reign of terror throughout Equatorial Africa.

ABSTRACT OF THE ADDRESS TO THE MECHANICAL SCIENCE SECTION OF THE BRITISH ASSOCIATION.

By William Henry Preece, F.R.S., M.Inst.C.E., etc.,
President of the Section.

"Canst thou send lightnings, that they may go, and say unto thee, Here we are?" were pregnant words addressed to Job unknown centuries ago. They express the first recorded idea in history of the potentiality of electricity to minister to the wants of mankind. From Job to Franklin is a long swing in the pendulum of time. It was not until that American philosopher brought down atmospheric electricity by his kite-string in 1747, and showed that we could lead it where we willed, that we were able to answer the question addressed to the ancient patriarch. Nearly another century elapsed before this mysterious power of nature was fairly conquered. It has been during this generation, and during the life of the British Association, that electricity has been usefully employed; and it is because I have taken a subordinate position in inaugurating nearly all of its practical applications, that I venture to make the developments of them the text of my address to this section.

People are singularly callous in matters affecting their own personal safety; they will not believe in mysteries, and they ridicule or condemn that which they do not understand. The Church itself set its face against Franklin's "impious" theories, and he was laughed to scorn by Europe's scientific sons; and even now, though commissions composed of the ablest men of the land have sat and reported on Franklin's work in England, France, and nearly every civilised nation, the public generally remains not only ignorant of the use of lightning conductors, but absolutely indifferent to their erection, and, if erected, certainly careless of their proper maintenance. I found in a church not very far from here the conductor leaded into a tombstone, and in a neighbouring cathedral the conductor only a few inches in the ground, so that I could draw it out with my hand. Although I called the attention of the proper authorities to the absolute danger of the state of affairs, they remained in the same condition for years.

Wren's beautiful steeple in Fleet-street, St. Bride's, was well-nigh destroyed by lightning in 1764. A lightning rod was fixed, but so imperfectly that it was again struck. In July last (1887) it was damaged because the conductor had been neglected, and had lost its efficiency.

As long as points remain points, as long as conductors remain conductors, as long as the rods make proper connection with the earth, lightning protectors will protect; but if points are allowed to be fused, or to corrode away; as long as bad joints or faulty connections are allowed to remain; as long as bad earths, or no earths exist, so long will protectors cease to protect; and they will become absolute sources of danger. Lightning conductors, if properly erected, duly maintained, and periodically inspected, are an absolute source of safety; but if erected by the village blacksmith, maintained by the economical churchwarden, and never inspected at all, a loud report will some day be heard, and the beautiful steeple will convert the churchyard into a new geological formation.

We have not yet acquired that mental confidence in the accuracy of the laws that guide our procedure in protecting buildings from the effects of atmospheric electrical discharges which characterises most of the practical applications of electricity. Some of our cherished principles have only very recently received a rough shaking from the lips of Professor Oliver Lodge, F.R.S., who, however, has supported his brilliant experiments by rather fanciful speculation, and whose revolutionary conclusions are scarcely the logical deduction from his novel premisses. The whole subject is going to be thoroughly discussed at this meeting.

We are now obtaining much valuable information about the nature of lightning from photography. We learn that it does not, as a rule, take that zigzag course conventionally used to represent a flash on canvas. Its course is much more erratic and sinuous, its construction more complicated, and pictures have been obtained of *dark* flashes whose *raison d'être* has not yet been satisfactorily accounted for. The network of telegraph wires all over the country is peculiarly subject to the effects of atmospheric electricity, but we have completely mastered the vagaries of lightning discharges in our apparatus and cables. Accidents are now very few and far between.

The art of transmitting intelligence to a distance beyond the reach of the ear and the eye, by the instantaneous effects of electricity, had been the dream of the philosopher for nearly a century, when in 1837 it was rendered a practical success by the commercial and far-sighted energy of Cooke, and the scientific knowledge and inventive genius of Wheatstone. The metallic arc of Galvani (1790) and the developments of Volta (1796) had been so far improved that currents could be generated of any strength, the law of Ohm (1828) had shown how they could be transmitted to any distances, the deflection of the magnetic needle by Oersted in 1819, and the formation of an electro-magnet by Ampère and Sturgeon, and the attraction of its armature had indicated how those currents could be rendered visible as well as audible.

Cooke and Wheatstone, in 1837, utilised the deflection of the needle to the right and the left to form an alphabet. Morse used the attraction of the armature of an electro-magnet to raise a metal style to impress or emboss moving paper with visible dots and dashes. Steinheil imprinted dots in ink on the different sides of a line on paper, and also struck two bells of different sound to affect the ear. Bréguet reproduced in miniature the actual movements of the semaphore then so much in use in France; while others rendered practical the favourite idea of moving an indicator around a dial, on which the alphabet and the numerals were printed, and causing it to dwell against the symbol to be read—the A, B, C instrument of Wheatstone in England, and of Siemens in Germany. Wheatstone conceived the notion of printing the actual letters of the alphabet in bold Roman type on paper—a plan which was made a perfect success by Hughes in 1854.

At the present moment the needle system of Cooke and Wheatstone, as well as the A, B, C dial telegraph, are very largely used in England on our railways and in our smaller post-offices. The Morse recorder and the Hughes type-printer are universally used on the continent; while in America the dot and dash alphabet of Morse is impressed on the consciousness through the ear by the sound of the moving armature striking against the stops that limit its motion. In our larger and busier offices the Morse sounder and the bell system, as perfected by Bright, are very largely used, while the press of this country is supplied with news which is recorded on paper by ink dots and dashes at a speed that is almost fabulous.

Sir William Thomson's mirror—the most delicate form of the needle system—where the vibratory motions of an imponderable ray of light convey words to the reader, and his recorder, where the wavy motion of a line of ink spirted on paper by the frictionless repulsion of electricity performs the same function, are exclusively employed on our long submarine cables.

Bakewell in 1848 showed how it was possible to reproduce facsimiles of handwriting and of drawing at a distance, and in 1879 E. A. Cowper reproduced one's own handwriting, the moving pen at one station so controlling the currents flowing on the line wire that they caused a similar pen to make similar motions at the other distant station. Neither of these plans, the former beautifully developed by Caselli and d'Arlincourt, and the latter improved by Robertson and Elisha Gray, have yet reached the practical stage.

The perfection of telegraphy has been attained by that chief marvel of this electrical age—the speaking telephone of Graham Bell. The reproduction of the human voice at a distance, restricted only by geographical limits, seems to have reached the confines of human ingenuity; and though wild enthusiasts have dreamt of reproducing objects abroad visible to the naked eye at home, no one at the present moment can say that such a thing is possible, while in face of the wonders that have been done no one dare say that it is impossible.

At the meeting of the Association in Plymouth in 1877, I was able for the first time in this country to show the telephone at work. Since then its use has advanced with giant strides. There are probably a million instruments at work now throughout the civilised world. Its development has been regularly chronicled at our meetings. As far as the receiving part of the apparatus is concerned, it remains precisely the same as that which I brought over from America in 1877; but the transmitter, ever since the discovery of the microphone by Hughes in 1878, has been entirely remodelled. Edison's carbon transmitter was a great step in advance; but the modern transmitters of Moseley, Berliner, D'Arsonval, De Jongh, leave little to be desired. The disturbances due to induction have been entirely eliminated, and the laws regulating the distance to which speech is possible are so well known that the specification of the circuit required to connect the Land's End with John O'Groat's by telephone is a simple question of calculation. A circuit has been erected between Paris and Marseilles, 600 miles apart, with two copper wires of 6½ gauge, weighing 540 lbs. per mile, and conversation is easily maintained between those important cities at the cost of three francs for three minutes. One scarcely knows which fact is the more astounding—the distance at which the human voice can be reproduced, or the ridiculously simple apparatus that performs the reproduction. But more marvellous than either is the extreme sensitiveness of the instrument itself, for the energy contained in one heat unit (gramme-water-degree) would, according to Pellat, maintain a continuous sound for 10,000 years.

The influence which electric currents exert on neighbouring wires extends to enormous distances, and communication between trains, and ships in motion, between armies inside and outside besieged cities, between islands and the mainland, has become possible without the aid of wires at all, by the induction which is exerted through space itself. On the Lehigh Valley Railway, in the United States, such a system of telegraphing without wires is in actual daily use.

Electric lighting has become popular, not alone from the beauty of the light itself, but from its great hygienic qualities in maintaining the purity and coolness of the air we breathe. The electric light need not be more brilliant than gas, but it must be more healthy. It need not be cooler than a wax candle, but it must be brighter, steadier, and more pleasant to the eye. In fact, it can be rendered the most perfect artificial illuminant at our disposal, for it can illumine a room without being seen directly by the eye; it can be made absolutely steady and uniform without irritating the retina; it does not poison the air by carbonic acid and carbonic oxide, or dirty the decorations by depositing unconsumed carbon; it does not destroy books or articles of vertu and art by forming water which absorbs sulphur acids; and it does not unnecessarily heat the room.

The production of light by any means implies the consumption of energy, and this can be measured in *watts*, or the rate at which this energy is consumed. A watt is $\frac{1}{746}$ part of a *horse-power*. It is a very convenient and sensible unit of power, and will in time replace the meaningless horse-power.

				watts
One candle light maintained by		tallow	absorbs	124
,,	,,	wax	,,	94
,,	,,	sperm	,,	86
,,	,,	mineral oil	,,	80
,,	,,	vegetable oil	,,	57
,,	,,	coal gas	,,	68
,,	,,	cannel gas	,,	48
,,	,,	electricity (glow)	,,	3
,,	,,	electricity (arc)	,,	55

The relative heat generation of these illuminants may be estimated from these figures.

Though the electric light was discovered by Davy in 1810, it was not until 1844 that it was introduced into our scientific laboratories by Foucault; it was not until 1878 that Jablochkoff and Brush showed how to light up our streets effectually and practically; it was not until 1881 that Edison and Swan showed how our homes could be illuminated softly and perfectly.

The greatest development of the electric light has taken place on board ship. Our Admiralty have been foremost in this work. All our warships are gradually receiving their equipment. Our ocean-going passenger ships are also now so illumined, and perhaps it is here that the comfort, security, and true blessedness of the electric light is experienced.

Railway trains are also being rapidly fitted up. The express trains to Brighton have for a long time been so lighted, and now several northern railways, notably the Midland, are following suit. Our rocky coasts and prominent landfalls are also having their lighthouses fitted with brilliant arc lamps, the last being St. Katherine's Point on the Isle of Wight, where 60,000 candles throw their bright beams over the English Channel, causing many an anxious mariner to proceed on his way rejoicing.

Fontaine showed in Vienna, in 1873, that a dynamo was reversible—that is, if rotated by the energy of a moving machine, it would produce electric currents; or, if rotated by electric currents, it would move machinery. An electric current is one form of energy. If we have at one place the energy of falling water, we can, by means of a turbine and a dynamo, convert a certain portion of the energy of this falling water into an electric current. We transmit this current through proper conductors to any other place we like, and we can again, by means of a motor, convert the energy of the current into mechanical energy to do work by moving machinery, drawing tramcars, or in any other way. We can in this way transmit and utilise 50 per cent. of the energy of the falling water wherever we like. The waste forces of nature are thus within our reach. The waterfalls of Wales may be utilised in London; the torrents of the Highlands may work the tramways of Edinburgh; the wasted horse-power of Niagara may light up New York. The falls of Bushmills actually do work the tramway from Portrush to the Giant's Causeway, and those of Bessbrook the line from Newry to Bessbrook.

The practicability of the transmission of energy by currents is assured, and the economy of doing this is a mere matter of calculation. It is a question of the relative cost of the transmission of fuel in bulk, or of the transmission of energy by wire. Coal can be delivered in London for 12s. per ton. The mere cost of the upkeep of a wire between Wales and London to deliver the same amount of energy would exceed this sum tenfold. For long distances the transmission of energy is at present out of the question. There can be no doubt, however, that for many purposes within limited areas the transmission of energy by electricity would be very economical and effective. Pumps are worked in the mines of the Forest of Dean, cranes are moved in the works of Easton and Anderson at Erith, lifts are raised in banks in London; water is pumped up from wells to cisterns in the house of Sir Francis Truscott, near East Grinstead; ventilation is effected and temperature lowered in collieries; goods, minerals, and fuel can be transmitted by telpherage.

The transmission of power by electricity is thus within the range of practice. It can be distributed during the day by the same mains which supply currents for light by night. Small industries, such as printing, watch-making, tailoring, boot-making, can be cheaply supplied with power. It is thus brought into direct competition with the distribution of power by steam as in America, or by air-pressure as in Paris, or by high-pressure water as in London; and the relative advantages and economies of each system are simple questions of calculation. When that evil day arrives that our supply of natural fuel ceases, then we may look to electricity to bring to our aid the waste energies of nature—the heat of the sun, the tidal wave of the ocean, the flowing river, the roaring falls, and the raging storm.

The property, which the electric current possesses, of doing work upon the chemical constitution of bodies so as to break up certain liquid compounds into their constituent parts, and marshal these disunited molecules in regular order according to a definite law upon the surfaces of metals in contact with the liquid where the current enters and exists, has led to immense industries in electro-metallurgy and electro-plating. The extent of this industry may be gathered from the fact that there are 172 electro-platers in Sheffield and 99 in Birmingham. The term electro-metallurgy was originally applied to the electro-deposition of a thin layer of one metal on another; but this is now known as electro-plating.

In 1839 Jacobi in St. Petersburg and Spencer in Liverpool laid the foundations of all we know of these interesting arts. Copper was deposited by them so as to obtain exact reproductions of coins, medals, and engraved plates. The first patents in this country and in France were taken out by Messrs. Elkington, of Birmingham, who still occupy the foremost position in the country.

The fine metals, gold and silver, are deposited in thin layers on coarser metals, such as German silver, in immense quantities. Christofle of Paris deposits annually six tons of silver upon articles of use and of art, and if the surfaces so electro-plated were spread out continuously they would cover 140 acres.

The whole of the copper plates used in Southampton for the production of our splendid Ordnance survey maps are deposited by copper on matrices taken from the original engraved plates, which are thus never injured or worn, are always ready for addition or correction, while the copies may be multiplied at pleasure and renewed at will.

Nickel-plating, by which the readily oxidisable metals like iron are coated with a thin layer of the more durable material nickel, is becoming a great industry; the trappings of harness, the exposed parts of machinery, the fittings of cycles and carriages and innumerable articles of daily use are being rendered not only more durable but more beautiful.

The electro-deposition of iron, as devised by Jacobi and Klein, in the hands of Prof. Roberts-Austen, F.R.S., is giving very interesting results. The dies for the coins which were struck at our Mint on the occasion of the Jubilee of the Queen, were modelled in plaster, reproduced in intaglio by the electro-deposition of copper, and on these copper moulds hard excellent iron in layers of nearly 1-10th of an inch was deposited.

The extraction of metals from their ores by deposition has received wide application in the case of copper. In 1871 Elkington proposed to precipitate copper electrolytically from the fused sulphide of copper and iron known to the copper smelter as "regulus." Thin copper plates were arranged to receive the deposited copper while the foreign metals, including gold and silver, fell to the bottom of the solution, the process being specially applicable, it was supposed, to regulus containing small quantities of the precious metals.

The electrical purification of copper from impure "blister copper" or "blade copper" has also made great progress, and special dynamos are now made which will, with an expenditure of 100 horse-power, precipitate 18 tons of copper per week. The impure metal is made to form the anode in a bath of sulphate of copper, the metal being deposited in the pure form on a thin copper cathode.

Both at Swansea and Widnes immense quantities of copper, in spite of the restrictive operations of the copper syndicate, are being produced by electro-deposition. Copper steam pipes for boilers are now being built up of great firmness, fine texture, and considerable strength by Mr. Elmore at Cockermouth, by electro-deposition on a rotating mandril in a tank of sulphate of copper. By this process one ton of copper requires only a little more than one ton of coal to raise the requisite steam to complete the operation.

It has been shown that the electrolytic separation of silver from gold by similar methods is perfectly practicable. The value of the material to be dealt with may be gathered from the fact, communicated to the "Gold and Silver Commission" now sitting, that nearly 90,000,000 ounces of silver are annually produced, and the greater portion of this amount contains sufficient gold to render refining remunerative. Although the old acid process of "parting" gold and silver remains practically undisturbed, there seems no reason to doubt that in the future electricity will render us good service in this direction as it has already in the purification of copper.

There is not much actual progress to report in the extraction of gold from its ores by electrical agency. The conversion of gold into chloride of gold by the direct, or indirect, action of chlorine is employed on a very large scale in [Grass Valley] California and elsewhere. This fact has led to well-directed efforts to obtain by electrolytic action, chlorine which should attack finely divided gold suspended (with the crushed ore) in the solution from which the chlorine was generated, the gold, so converted into soluble chloride, then being deposited on a cathode. The process would seem to be hopeful, but is not as yet a serious rival to the ordinary chlorination method.

In the amalgamation of gold ores much is expected from the possibility of keeping clean, by the aid of hydrogen set free by the electric current, the surfaces of amalgamated plates.

It is well known that the late Sir W. Siemens considered that the electric arc might render good service in the fusion of metals with high melting points, and he actually succeeded in melting 96 ounces of platinum in ten minutes with his electrical furnace. The experiments were interrupted by his untimely death, but in the hands of Messrs. Cowles the electric arc produced by 5,000 ampères and 500 horse-power is being employed on a very large scale for the isolation of aluminium (from corundum), which is immediately alloyed (*in situ*) with copper or iron, in the presence of which it is separated.

The heating power of large currents has been used by Elihu Thomson in the United States, and by Bernardos in Russia, to weld metals, and it is said to weld steel without affecting its hardness. It has even been proposed to weld together in one continuous metallic mass the rails of our railways so as to dispense entirely with joints.

The production of chlorine for bleaching and of iodine for pharmaceutical purposes, the economical production of oxygen, are also processes now dependent on the electrolytic effect of the electric current.

It is almost impossible to enumerate the various general purposes to which electricity is applied to minisier to our wants, and to add to our comforts. Every one appreciates the silent efficiency of the trembling electric bell, while all will sooner or later derive comfort from the perennially self-winding electric clock. Correct mean time is distributed throughout the length and breadth of the land by currents derived from Greenwich Observatory. Warehouses and shops are fitted with automatic contact pieces, which, on any undue increase of temperature due to fire, create an alarm in the nearest fire station; and at the corner of most streets a post is found with a face of glass, which on being broken enables the passer-by or the watchful and active policeman to call a fire-engine to the exact spot of danger. Our sewers are likely to find in its active chemical agency a power to neutralise offensive gases, and to purify poisonous and dangerous fluids. The germs of disease are attacked and destroyed in their very lairs. The physician and the surgeon trust to it to alleviate pain, to cure disease, to effect organic changes beyond the reach of drugs. The photographer finds in the brilliant rays of the arc lamp a miniature sun which enables him to pursue his lucrative business at night, or during the dark and dismal hours of a black November fog of London.

We learn from the instructive and interesting advertising columns of our newspapers that "electricity is life," and we may perhaps read in the more historical portion of the same paper that by a recent decision of the New York Parliament, "electricity is death." It is proposed to replace hanging by the more painless and sudden application of a powerful electrical charge; but those who have assisted at this hasty legislation would have done well to have assured themselves of the practical efficacy of the proposed process. I have seen the difficulty of killing even a rabbit with the most powerful induction coil ever made, and I know those who escaped and recovered from the stroke of a lightning discharge.

The fact that the energy of a current of electricity, either when it flashes across an air space or when it is forced through high resistance, assumes the form of heat of very high temperature led early to its employment for firing charges of gunpowder; and for many civil, military, and naval purposes it has become an invaluable and essential agent. Wrecks like that of the Royal George at Spithead were blown up and destroyed; the faces of cliffs and quarries are thrown down; the galleries of mines and tunnels are excavated; obstructions to navigation like the famous Hell Gate, near New York, have been removed; time guns to distribute correct time are fired by currents from Greenwich at 1 p.m. In the operations of war, both for attack and defence, submarine mining has become the most important branch of the profession of a soldier and a sailor. Big guns, whether singly or in broadside, are fired, and torpedoes, when an enemy's ship unwittingly is placed over them, are exploded by currents of electricity.

An immense amount of research has been devoted to design the best form of fuse, and the best form of generator of electricity to use to explode them. Gun tubes for firing consist of a short piece of very fine wire embedded in some easily fusible compound, while the best form of fuse is that known as the Abel fuse, which is composed of a small, compact mass of copper phosphide, copper sulphide, and potassium chlorate. The practice in the use of generators is very various. Some, like the Austrians, lean to the high tension effects of static electricity; others prefer magneto machines; others use the dynamo; while we in England cling with much fondness to the trustworthy battery. Since the electric light has also become such a valuable adjunct to war purposes, it is probable that secondary batteries will become of immense service. The strong inductive effects of atmospheric electricity are a source of great danger. Many accidental explosions of fuses have occurred. An experimental cable with a fuse at one end was laid below low-water mark along the banks of the Thames at Woolwich. The fuse was exploded during a heavy thunderstorm. The knowledge of the causes of a danger is a sure means for the production of its removal, or of its reduction to a minimum. Low tension fuses and metallic circuits reduce the evils of lightning, but have not removed them. Should war unhappily break out again in Europe, submarine mining will play a very serious part, and, paradoxical as it may appear—as has been suggested by the French ambassador, M. Waddington—its very destructiveness may ultimately prove it to be a powerful element of peace.

(To be continued.)

NOTICES.

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METEOROLOGICAL RETURNS

For the ten weeks ending on Monday, August 27th, 1888. Specially prepared for SCIENTIFIC NEWS from official reports

	Mean Temperature.	Rainfall.	Duration of Sunshine.
Scotland, East	53·6 degs., being 3·6 degs. below average.	7·0 ins., being 0·3 ins. above average.	328 hrs., being 52 hrs. below average.
England, N.E.	54·5 " " 4·0 " " "	8·1 " " 2·2 " " "	260 " " 107 " " "
England, East	57·5 " " 3·8 " " "	8·4 " " 3·0 " " "	295 " " 147 " " "
Midlands ...	56·7 " " 3·6 " " "	7·8 " " 1·6 " " "	284 " " 118 " " "
England, South	58·3 " " 2·8 " " "	7·9 " " 2·1 " " "	293 " " 152 " " "
Scotland, West	55·5 " " 1·4 " " "	8·9 " " 0·7 " " "	345 " " 29 " " "
England, N.W.	56·3 " " 3·2 " " "	10·0 " " 1·9 " " "	310 " " 69 " " "
England, S.W.	57·2 " " 2·9 " " "	9·4 " " 1·7 " " "	381 " " 109 " " "
Ireland, North	56·6 " " 2·3 " " "	9·8 " " 3·1 " " "	321 " " 19 " above "
Ireland, South	57·3 " " 1·8 " " "	8·6 " " 1·6 " " "	365 " " 8 " " "
The Kingdom...	56·4 " " 2·9 " " "	8·6 " " 1·8 " " "	318 " " 76 " below "

During the corresponding period of last year the rainfall for the kingdom was 3·6 inches, or 3·2 inches below the normal; sunshine was 508 hours, or 114 hours above the normal.

Scientific News

FOR GENERAL READERS.

VOL. II. SEPTEMBER 14, 1888. No. 11.

CONTENTS.

The British Association.

MR. PREECE'S ADDRESS.—To further the "advancement of science" we should have welcomed a little more light and leading than is to be found in the address of the President of the Mechanical Section. Mr. Preece is an electrician, and electricity was his theme, and we cannot but feel that he was not quite equal to the occasion. It is true he gave an interesting historical *résumé* of many of the applications of electricity, and that he pleased many of his hearers by the popular nature of his discourse, but the thoughtful and the scientific could not but have been disappointed. It is one thing to popularise scientific information in the sense of making it understood by those who have not been trained technically; it is another thing to give a rather common-place record of results more or less known, without any touches of the master mind.

It must not, however, be supposed that no grains of wheat were to be found amongst the chaff. Mr. Preece did good service in again calling attention to the ignorance and indifference of the public about the proper treatment of lightning conductors. If they are properly erected, duly maintained, and periodically inspected, they are an absolute source of safety; "but," says Mr. Preece, "if they are erected by the village blacksmith, maintained by the economical churchwarden, and never inspected at all, a loud report will some day be heard, and the beautiful steeple will convert the churchyard into a new geological formation." Speaking of the development of telegraphy, Mr. Preece mentioned that since the Government took over the telegraphs the number of messages has increased from six to fifty-two million per annum. On one important occasion as many as 1,500,000 words were sent from the Central Telegraph Office in London in one night. On the subject of electric lighting at the Central Savings Bank in London, Mr. Preece made a rather novel calculation. He said that after two years' experience the average absences from illness had been reduced by about two days a year for each person on the staff, and that this was equivalent to a gain to the service of the time of about eight clerks in that department. Taking this into account, he then estimated that the electric lighting costs £266 less than lighting by gas.

As regards the telephone, it appears that in and about New York there are 15,000 subscribers, but in London there are only 4,851, even Stockholm having more subscribers than our own capital. As a Government official, Mr. Preece was, however, careful not to suggest that the probable reason of this slow development was the well-known restrictive action of the Government.

After speaking of the transmission of power by electricity being within the range of practice, Mr. Preece added these words of comfort, "When the evil day arrives that our supply of natural fuel ceases, then we may look to electricity to bring to our aid the waste energies of nature—the heat of the sun, the tidal wave of the ocean, the flowing river, the roaring falls, and the raging storm." We trust, however, that as a nation we shall not allow ourselves to be prodigal of fuel, because of the power we may derive from the sun we so seldom feel, or from the raging storms which come at such uncertain intervals.

Mr. Preece referred to the progress made in the application of electricity to electro-metallurgy and electroplating, and speaking of the electrolytic separation of silver from gold, he mentioned that nearly ninety million ounces of silver are produced annually, and that the greater portion of it contains sufficient gold to render refining remunerative. He also referred to the very powerful electric furnaces now used for aluminium, and the alloys formed with it. The welding of metals, including steel, can now be effected by electricity, and Mr. Preece said it was even proposed to weld together in one continuous length the rails of our railways, so as to dispense entirely with joints! Later on he took occasion to speak rather slightingly of physicists as mere theorists, but if the superior "practical" electrician ignores the contraction and expansion of several miles of continuous iron rails, no wonder there is a want of agreement between them.

PROFESSOR AYRTON'S LECTURE.—The Friday evening discourse of Professor Ayrton on the Electrical Transmission of Power was a great success. Professor Ayrton has not only a thorough knowledge of his subject, but has also the valuable gift of explaining it in a clear and forcible manner. Moreover, he performed a well-arranged series of experiments which were very successful. In the course of his remarks he stated that it was well known that large steam engines could be worked more economically than small ones, and from this he argued that if it were possible to transmit *economically* the power from a few large engines to a great number of small workshops there would be a great saving of power, as well as a great saving of time.

He pointed out that there are four methods of transmitting power to a distance: by a moving rope, by air compressed or rarified, by water forced through a pipe, and by electricity. Hitherto the distribution of power by water pressure has been most in favour in this country, but Professor Ayrton is of opinion that the electric transmission of power, even now, bids fair to surpass all other methods, for the following reasons: It is economical in fuel; it gives more perfect control over each individual machine; tools can be brought to the work, instead of the work being taken to the tools; there is greater cleanliness; and finally the power which during the day-time might be mainly used for driving machinery, could, in the easiest possible way, be used during the night for giving light. By turning a handle one way the electric current could be made to work an electric motor, and by turning it the other way the current which would come and return by the same wires as before, could be used for electric lighting. Professor Ayrton remarked that it might be said that the transmission of power by coal-gas fulfilled this condition, but so also did the transmission by a loaded coal waggon. In both these cases it was the fuel itself that was transported, not the power.

The chief attraction of the evening was the welding of iron and steel bars one inch square in section by by a high tension current transmitted through a small wire. Aluminium was also welded quickly by the same means. It has yet to be proved whether or not this sudden heating of the metals can be effected without subjecting them to excessive strains, but the mere fact of being able to weld so quickly and so easily was of itself very striking. In conclusion Professor Ayrton showed a working model of the "Telpher Line," invented by the late Professor Fleeming Jenkin, Professor Perry, and himself.

Discovery of an Ancient City.—In the north-east of the province of Chihuahua there have been found, according to the *Revue Française de l'Etrangère*, the remains of an ancient city excavated and sculptured in the rocks like Petra in the land of Edom. No traditions concerning this city survive, but the ruins show that its prehistoric inhabitants must have been civilised. There are hundreds of rooms hewn in the solid rock on the side of the mountain, and the stone extracted has served for buildings. There are many heights of rooms and stairs cut in the rock leading from house to house. In many places the rock is elegantly sculptured and polished.

Legal Standards of Time.—M. Bouquet de la Grye, in a communication to the Academy of Sciences, mentions a project for the adoption of a uniform time throughout France, Algeria, and Tunisia. The standard adopted will drobably be Paris time.

Earthquake in Greece.—Two violent shocks of earthquake occurred on September 10th at Vostitza, in the Northern Peloponnesus. Great destruction was caused to property.

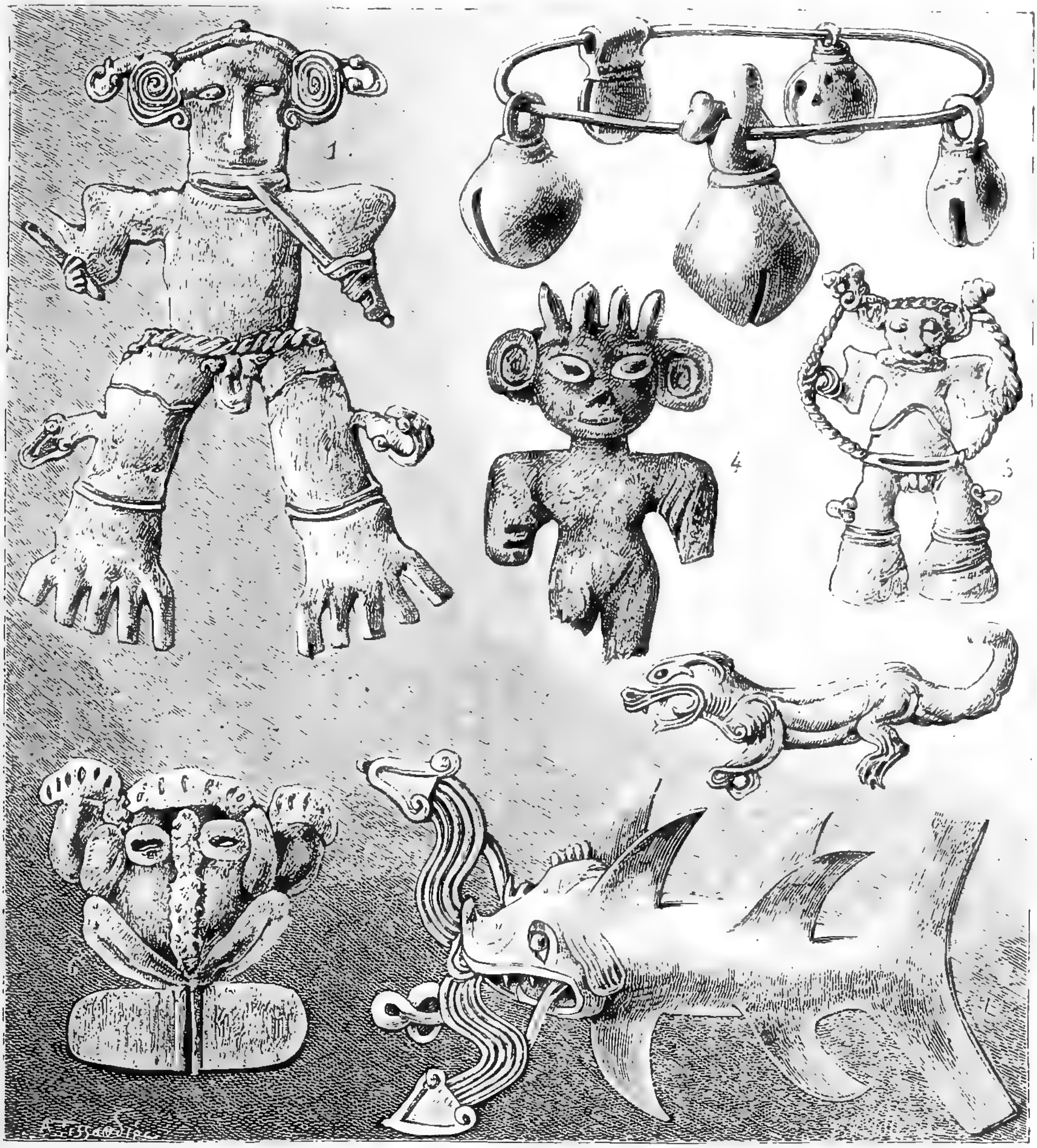
The Buffon Centenary.—On the 17th of this month the centennial anniversary of the death of Buffon will be solemnised at Montbard.

THE HUACAS OF CHIRIQUI.

The ancient tombs in Central America, which are known in the Spanish-American of the country by the name of "huacas," abound in interesting relics of long past generations.

The whole coast of the Isthmus of Darien, especially on the shore washed by the Pacific, is thickly studded with these "huacas," but those at Chiriqui, on the Atlantic coast, are for the most part in a better state of preservation than those elsewhere. Until within the last few years, Chiriqui was almost an unknown land, having apparently even evaded the notice of the Spanish conquerors, although they penetrated into many parts of Darien and Panama, but the proposed cutting of a connecting canal between the Atlantic and Pacific Oceans, necessitating careful engineering surveys of the isthmus, has brought the district into comparatively prominent notice. The first important discoveries of old-world relics took place in 1858, when two workmen, in the course of their digging, unearthed a small gold figure, and incited by this unlooked-for treasure to further investigations, continued their excavations with an ardour which soon met with a very ample reward. The report of their success rapidly spread abroad, and within twelve months of the date of the first discovery the ground for miles around was furrowed with the excavations of eager treasure-seekers, most of whom reaped a wonderful harvest of idols, ornaments, etc., in gold and copper. Unfortunately, however, the interest since taken in the primitive races of America was then only in its infancy, and the greater part of these ornaments, which might perhaps have thrown important lights upon the ethnology of Central America, was melted down for the sake of the metal of which they were composed. Only comparatively few specimens were preserved intact from these first excavations, but happily their discoverers left in some cases copious notes as to the tombs where they were found, and it is partly to this earlier testimony, corroborated by the experiences of later days, that we owe much of our knowledge on the subject. As in parts of Peru, the tombs in Chiriqui are sometimes square, sometimes oval; they are arranged without regard to any particular direction, extending to a depth of some eighteen feet beneath the surface of the soil, and are lined with rough stones covered with a kind of paving stone, which must have been brought, in most instances, from a considerable distance. The ground was covered with pebbles, upon which the corpse was laid, wrapped in a simple shroud, the elaborate garments and bandages of the Peruvian mummies being absent. These corpses are commonly called "mummies," but the term is, as a matter of fact, a misnomer, these bodies owing their preservation to the lightness of the soil and air, and not to any artificial process, as in the case of the true mummy of the Egyptians and of the Guanchos (the aborigines of the Canary Isles), where the body underwent an elaborate process of embalming with resinous gums, salts, or wax.

In the "huacas" of Chiriqui the skeletons of the dead, save occasional fragments, have, in many cases, disappeared, the atmosphere there being apparently deficient in those marvellous properties of the atmosphere of Western Peru, which have preserved the bodies in the coast tombs in a condition almost as perfect as that ensured for the Egyptian mummies by the old embalming. The relatively destructive effects of the air have, however, had but little influence upon the stone, pottery, and metal objects found in the Chiriqui tombs, deposited there, as was the case throughout the whole of America, by the mourning relatives, who invariably buried with their dead the implements, ornaments, toys, etc., which they had used during life. As in most of the North American mounds, articles made of rough terra-cotta are more numerous than are the arms and tools of stone and wood, and are only exceeded in quantity by the ornaments made of gold, silver, copper, and tin, and sometimes even of a skilful mixture of the two latter, forming a good durable bronze. In the Museum at Washington there are more than four thousand pottery articles of divers shapes, all collected from the tombs at Chiriqui, some simple vessels for holding foods, cooking utensils, or drinking vessels, others fashioned of baked clay in the strange devices of the ornamental art of those primitive days, sometimes rude representations of animals or reptiles, as, for example, the frog (No. 6) in the accompanying engraving, which we borrow from our courteous contemporary *La Nature*. The metal images, idols, etc., have given rise to some discussion as to whether they were made by means of casting or by simple hammering; the generally accepted opinion at the present day inclining to the theory that the artist had recourse to a method still employed in some countries of the East, namely, that he modelled his subject in some fusible substance, wax



Ornaments found in the Huacas of Chiriqui.

or resin, for example, then covered it with a thick coat of potter's clay, and exposed it to fierce heat. The inner model melted away, and left the hardened clay as a mould into which could be poured the molten metal. It is possible that sometimes a mixture of gold and mercury was used; this being more pliable, could be modelled to the required shape, exposed to heat, and finished by the aid of coarse tools; the little figures numbered 1, 3, and 4 in our illustration, were probably made in this manner, as were also many of the Peruvian ornaments. The artists of Chiriqui do not appear to have understood the art of engraving or of embossing, judging at least from the fact that no specimens of such work have hitherto been found in their huacas, but they were very clever in joining the separate parts of their designs together, the joins being often almost invisible, and were also very deft in their manipulation of fine gold wire, frequently attaching extra ornamentation to their figures by means of twisted wires. Fig. 3 shows a good example of this kind of work. Occasionally objects, instead of being made of pure gold, are made of copper, gilded, while others are plated with a layer of gold, as sometimes occurs in the North American mounds, where, however, the gold is often supplanted by iron, which in those early days was accounted rather more precious than the less rare gold. How these various metals were all worked together, and how the more elaborate ornamentation was achieved, remains to this day an unsolved problem, for it seems inexplicable that a people whose ideas of imitative arts were, as the representations of human figures, animals, etc., clearly prove, primitive to a degree, should yet have been so far advanced in metallurgic craft.

One is sometimes tempted to imagine that these models of the human form divine must have been intended as grotesque caricatures, and not as *bona-fide* copies from the original, though it must be confessed that birds and animals also obtain but scant justice at these artists' hands. Eminently unsatisfactory though these achievements appear to us in the light of nineteenth century art criticism, yet the Chiriqui artists seem to have taken great delight in these reproductions from life, sharing in this respect a predilection manifested throughout the whole of Central America. After the human form, the owl, eagle, parrot, and frog seem to have been the most popular models, but animals and fish of divers species were also pressed into the service. The puma (No. 5 of the illustration) we accept as such, purely by faith, on the strength of *La Nature's* asseveration that it is a puma; we ourselves might have been puzzled to decide which family of the animal world could fairly claim so curious a specimen. The fish (No. 7) is evidently symbolic of some old tradition, and is a decided improvement in point of both design and execution upon some of the artistic efforts of the same date. The Chiriqui artificers did not confine themselves solely to these images and models of animate objects as their only branch of decorative art; they were also expert in the manufacture of amulets, beads for necklaces, pins, bells, whistles, etc., made in pure gold or in an alloy of gold and copper, and even produced flat medallions of gold, etc., with added ornamentation, pierced with holes at the top, evidently intended to be worn round the neck as medals of honour. One of these medallions in the Museum, Washington, measures about 28 inches in diameter. Occasionally the bells were made of bronze, gilded, elongated in shape, with apertures at the bottom for the sound to escape, and containing little metal balls to serve as clappers. They were frequently suspended on a gold wire (as in Fig. 2).

The Marquis de Madaillac, in his interesting paper on the subject in *La Nature*, to which we are indebted for much of the above information, draws attention to a significant fact—the great disparity between the amount of metal produced by the country and that used by the inhabitants in the manufacture of the countless ornaments, etc., found in such numbers in all parts of the isthmus. There are no traces of ancient mines in this particular district, and, so far as we know, no veins of metalliferous deposit, and although there is a certain amount of gold in the form of dust and small nuggets found in the rivers, it seems very improbable that this supply could ever have been sufficient to meet the demand in those old days of metallurgic industry. The raw material must therefore have been imported from other countries, and the inhabitants of Chiriqui must have had, at a very early date, intercourse with other and distant nations. It is interesting to observe, however, that this intercourse had no perceptible effect upon the artistic productions of the Chiriquians, their art being distinctly of native origin, and bearing no traces of foreign influence, either Peruvian or Mexican.

BIRDS' TONGUES.

WE are rather accustomed, most of us, to look upon the tongue as primarily and finally an organ of taste and of speech. Such are the functions which it fulfils in ourselves; and, although speech is a faculty not granted to mammals, we know that their sense of taste, if not always very keen, is certainly not wanting. And so, in them, we are apt to consider the tongue as an instrument of that special sense, seldom realising that it may have other duties to perform, and those very possibly of a far more important character. And this, in point of fact, we find to be the case in such mammals as the lion, the giraffe, and the ant-eater. In the first of these the tongue becomes a rasp, suitable for scraping the flesh of a victim from the bones; in the second it is an instrument of prehension, adapted for plucking the foliage of trees; and in the third it is principally a weapon, lubricated with a kind of natural bird-lime, which causes ants and other small insects to adhere to it as it is swept to and fro among them. Yet there can be no doubt that, in the generality of mammals, it *is* an organ of taste, and very little else, although in some it has its uses as an auxiliary in mastication.

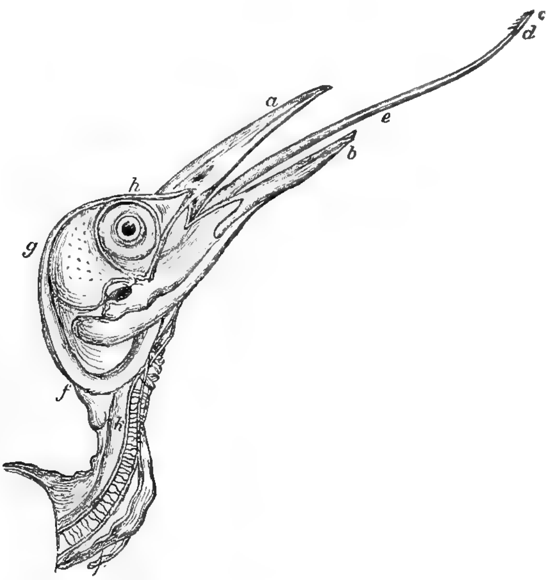
In the birds, however, the sense of taste seems almost wholly wanting; and, even were it present, it is difficult to see in what manner it could be of service. For many birds—most birds, in fact—swallow their food without any sort of preparation in the mouth. They are entirely without teeth—now-a-days—and therefore mastication is impossible. And so we find that predacious birds, insect-eating birds, fruit-eating birds, and seed-eating birds alike almost invariably swallow their food in such a manner that its flavour could not by any possibility be appreciated by the nerves of taste, even were such nerves not only present, but present in a highly developed degree.

The tongue, therefore, when present in any but a rudimentary form, is adapted to fill far other offices than that of mere sensual gratification. It is, indeed, generally covered with a sheath of horn —an evident sign that the sense of taste must be wanting—and it becomes, usually, either an instrument for the capture of living prey, or else one for the extraction of liquid nourishment from honey-bearing flowers. Or, as in the parrots, it may serve as a kind of thumb, and, being opposable to the upper mandible, assist greatly in holding and turning nuts, seeds, or morsels of fruit. And, following the invariable rule of Nature, it is in all such cases considerably modified, always in such a manner as best to adapt it to the duties which it is called upon to perform.

In the woodpeckers it is especially curious. These, as no doubt most of us know, are birds whose task it is to extract wood-boring insects from their burrows, and in so doing to chip away the unsound wood in which they have made their home; thus performing a kind of rough surgery which may not impossibly save a slightly-diseased tree from death, just as a human operator, by cutting away diseased flesh, prolongs or preserves the life of his patient. Therefore do we find, in these birds, that not only does the beak constitute a sort of natural chisel, but that the tongue is specially modified in order that it may perform the actual task of capture; for that is a work for which the bill itself is obviously unsuited. The one instrument cuts away the wood and exposes the insects to view; the other must capture them. And therefore modification takes place in a very remarkable degree.

In the first place, the hyoid bones, which support the base of the tongue, and which also serve as an attachment for the important muscles of the throat, are greatly lengthened, and, passing over the back of the head, are fastened into the skull just above the right nostril; and they are accompanied by a narrow strip of muscle, by means of which they are moved. Thus great elasticity at the base of the tongue is provided. That organ itself is extremely long and slender—almost filamentary, in fact—and is terminated by a long horny appendage, sharply pointed at the extremity, and covered with small barbs, the points of which are directed down the throat. Finally, the saliva, as in the ant-eater among mammals, and in the chameleon among reptiles, is of a highly glutinous consistency. Thus, when the tongue is inserted into the burrow of a wood-boring insect—first enlarged by the beak—the tenant, if a small one, adheres to the extremity by reason of the glutinous saliva; if a larger, the reversed barbs drag it from its retreat. It was formerly asserted that these barbs transfixed the victim, but this is now denied. It may well be, however, that in the case of a powerful insect the sharply-pointed horny tip itself does so, thus killing, or at any rate greatly weakening it, and enabling it to be withdrawn with comparative ease.

In the night-jars, the martins, the swallows, and the swifts, we find the saliva again playing a very important part in the capture of prey, although the tongue is not developed. In the titmice, however, we have an approach to the woodpecker structure, for the tongue, which is shaped at the extremity something like a "J" pen, is terminated by four reversed spines—two upon either side; and the saliva is again of a highly glutinous character. Thus these little birds are enabled to extract small insects from the crevices and crannies in the bark of trees, and especially from those in the lower surface of the branches, wherein they are perfectly safe from the attacks of birds in general.



HEAD OF A WOODPECKER, SHOWING—
a, upper mandible; *b*, lower ditto; *c*, *d*, *e*, tongue; *f*, *g*, *h*, hyoid bones.

In the humming-birds, those gems of the feathered race, we once more find the woodpecker structure very closely followed. The hyoid bones are again carried over the top of the skull and terminated upon the forehead, and the tongue is again long and thread-like (although double nearly to its base), so that it can penetrate to the base even of the long, bell-shaped flowers which are so plentiful in some of the South American forests, and extract the liquid treasures as well as the small insects which are to be found therein; for the humming-birds are fond of a mixed diet, and eat both honey and insects. In the honey-eaters themselves, or *Meliphagidæ*, the tongue is terminated by a tuft of slender fibres, which evidently answer the purpose of a brush.

Many birds possess a varying number of small spines near the base of the tongue, always set in such a manner that the points are directed down the throat. Probably these aid in some degree in the operation of swallowing, and are analogous to the double row of teeth which we find upon the palates of the non-venomous serpents, and which bear so very important a share in the task of deglutition. In the duck, however, and also in some of its near relatives, these spines are considerably extended in their range, the last inch or so of the tongue itself being fringed with delicate bristles, while on either side of the organ are five sharp spines of some little size, the intervening spaces being again occupied by a row of slender bristles. Finally, upon the upper surface of the tongue are two small bony projections, which seem to correspond with four spines situated opposite to them upon the upper jaw. This rather complicated structure appears, in concert with the corrugated margins of the beak itself, to assist in the filtration of the mud, etc., from which these birds extract so large a proportion of their food.

In the parrots, as already stated, the tongue, which now assumes the form of a thick, fleshy organ, fulfils the duties of a thumb, the upper mandible, to which it can be opposed, in like manner serving as a finger. Probably most of us are acquainted with the facility with which a parrot turns and twists a nut, a large seed, or any similar article of diet; and it is to the character of the tongue, also, that these birds owe their singular powers of articulation. On the other hand, there are many birds, and among them some of the largest, in which that member is scarcely developed at all. In the ostrich, for example, it is little more than an inch in length, and there is some difference of opinion among ornithologists as to whether, in this particular instance, it is actually the tongue itself or only the epiglottis. And there are a great number of birds in which it is more rudimentary still, and which, for all practical purposes, are without tongues at all.

ON THE GIGANTIC DIMENSIONS OF CERTAIN FOSSIL MAMMALIA.

M. ALBERT GAUDRY, in a memoir read before the Paris Academy of Sciences, states that he has just received from M. Strauch, the Director of the Museum of the St. Petersburg Academy of Sciences, some photographs of the celebrated mammoth of that collection.

The mammoth (*Elephas primigenius*) of the St. Petersburg Museum is that whose entire body was found, in 1799, upon the shore of the Icy Ocean, near the mouth of the Lena. As seven years had intervened between its discovery and its arrival at St. Petersburg, a part of its flesh had been devoured by dogs and other ferocious beasts, and the greater portion of the remainder had been detached from the bones, as it rendered the conveyance too difficult. The photograph shows that the skin and the flesh have only been preserved on the head and around the feet.

According to Tilesius, the skeleton is 11 ft. 2½ in. in height from the top of the head to the sole of the feet. It is not so large as the skeleton of *Elephas meridionalis* from the pliocene of Durfort, which is in the new gallery of the Paris Museum. The Durfort skeleton is 12½ ft. in height at the withers, and 13 ft. 10 in. to the top of the head. In length it is 21 ft. 8 in. from the ends of the tusks to the posterior margin of the pelvis, and 17 ft. 5 in. from the front of the head (not including the tusks) to the hinder margin of the pelvis. These dimensions are very superior to those of our skeleton of the mastodon from Sanram, and surpass even those of the gigantic American mastodons. The Durfort skeleton is the largest entire mammalian skeleton known at present.

We have separate bones which must have belonged to still mightier beasts. Thus M. Haussmann, when Prefect of the Seine, presented to the Museum a humerus of *Elephas antiquus*, found quite near Paris, in the quaternary of Montreuil-sous-Bois; this bone measures 50 in., whilst that of the *Elephas meridionalis* of Durfort measures only 48 in. M. Gandry brought from Pikermi a tibia of a *Dinotherium*, which is to that of the Durfort elephant as 94 to 80, and the metacarpal bones present quite as great a difference.

If the proportions between the tibia, the humerus, the metacarpals, and the total height of the skeletons have been the same in *Elephas antiquus* and in *Dinotherium giganteum* as in the *Elephas meridionalis* of Durfort, we must suppose that *Elephas antiquus* reached the height of 14½ ft. to the top of the head, whilst the Dinotherium was no less than 16¼ ft. in height. Thus three tall men standing on each other's shoulders would scarcely reach the top of the head of the *Dinotherium giganteum* of Pikermi.

It is natural to find the maximum of stature in the Dinotherium, for this majestic creature reigned along with two species of mastodons, an *ancylotherium*, a giraffe, and a *helladotherium*, at the epoch of the upper miocene—the culminating point of the animal world. The *Elephas meridionalis* and the *Elephas antiquus* lived along with hippopotami in the hot stages of the pliocene and the quaternary, when there must have been a rich vegetation. If anything may astonish us, it is that the mammoth of the glacial lands of Siberia, dwelling in regions too cold to have a forest vegetation, should attain the great stature of the St. Petersburg skeleton.

The mightiest mammalia may thus be classed in order of magnitude :—

1st. *Dinotherium giganteum*, from the Upper Miocene of Attica.

2nd. *Elephas antiquus*, of the Quaternary (hot phase) of the neighbourhood of Paris.

3rd. *Elephas medionalis*, of the Upper Pliocene of Durfort (Gard).

4th. *Mastodon Americanus*, of the Quaternary of the *United States*.

5th. *Elephas primigenius*, of the Quaternary of Siberia, and the present elephants.

It is not probable that man has seen the Dinotherium, but it is certain that he has been face to face with *Elephas antiquus* and the mammoth. To combat them he had only flint weapons, and yet he conquered them. This enables us to believe that our forefathers of the quaternary were not lacking in intelligence and courage, although it is also possible that some o these gigantic creatures were conquered not by man but by climatic changes.

LENGTH OF HUMAN ENDURANCE UNDER WATER.—According to the recent investigations of M. Lacassagne, the longest time that a diver can remain under water is four minutes.

General Notes.

NATURAL GAS.—The Chinese obtain and utilise natural gas, especially near the town of Tsulin-Tsing, in Su-Tchuan. The gas, when reached, which is at depths of 500 to 600 yards, is conveyed away in pipes of bamboo, and is to a great extent used for boiling down the lime from the neighbouring salt-mines. Below the salt lie deposits of petroleum.

THE GREENLAND EXPEDITION.—The *Jason*, which conveyed Dr. Mansen and his fellow-explorers from Iceland to the east coast of Greenland, has recently returned to Norway. It landed the daring adventurers on July 17th in 65° 2′ N. lat. upon the ice, at about ten miles from the coast. There was every reason to suppose that they would reach the land in safety, the ice being apparently solid and continuous.

THE SATELLITES OF MARS.—M. E. Dubois (*Comptes Rendus*) suggests that Phobos and Deimos may have been two members of the large group of small planets circulating in the region between Mars and Jupiter, which having passed excessively near to Mars have recently become his satellites. This conjecture would account for the fact that they had never been observed prior to the month of August, 1877.

THE VAPOUR TENSIONS OF ALCOHOLIC SOLUTIONS.—M. F. M. Raoult (Academy of Sciences) had some time ago concluded that one molecule of a solid, non-saline substance on dissolving in 100 molecules of any volatile liquid whatever, diminishes the vapour-tension of the liquid by a constant fraction of its value close upon 0·0104. He now finds that this law extends to metallic salts as well as to organic bodies.

CAUSES OF BALDNESS.—The alleged causes of baldness are undue nervous strain, excessive heat from head-covers, constriction of the blood-vessels of the head by tight hats. In opposition to the two latter theories, Mr. G. O. Rogers (*Popular Science Monthly*) cites the fact that the Parsees of Bombay never have their heads uncovered, and when out of doors wear a very stiff, tall hat, fitting tightly to the head. Yet among them baldness is said to be unknown.

THE SUBSIDENCES OF THE EARTH'S SURFACE.—This subject, with especial reference to France, has recently been carefully studied by M. C. M. Goulier. He concludes that the movements of the ground, the existence of which along the coasts has long been established, especially along the north of France and Holland, take place also in the interior of continents, and that with an intensity and a complexity little suspected.

ARCHÆOLOGICAL DISCOVERIES.—Reports have lately appeared in Austrian and German papers of discoveries of Roman antiquities made within the last few weeks. At Doboj, in Bosnia, the remains of a fortress, erected probably to hold the Dacians in check, were traced by Dr. Tuhelka, who is the *custos* of ancient monuments in Bosnia. They lay on the summit of a cliff, which is at the junction of the Bosnia and Usura, and were covered with a shallow layer of mould. The ruins formed a series of terraces, at the highest point of which was a sort of citadel. An inscription was found, which showed that at some time the first Belgic cohort was in garrison at the spot. The utterly shattered condition of the remains of masonry, which are simply rubbish, indicates that they have been the scene of some great catastrophe. It has been suggested that an earthquake may have been the destructive agent, for a quantity of broken skeletons have been found buried in the greatest confusion all over the place in crumbled masonry and mortar. The place is an admirable situation for defence, being practically impregnable on two sides; and it dominates the surrounding country. Various articles, such as would be likely to be found in a Roman military colony, have been collected from the ruins. At Deutsch Altenburg, supposed to be the site of the ancient Carnumtum, not far from Pressburg, the outline of a circus has been traced, and much of the interior has been laid bare. The place has been for centuries tilled, all the remains being covered over with a rich loam, in some places only a few inches deep. This has, no doubt, chiefly contributed to the very perfect preservation of the ground plan. The *Oderzeitung* reports the finding in the Lossow district, near Frankfort on the Oder, of about 30 clay vessels of various sizes and patterns, some urns, some pots, deep saucers, flasks, etc. They were filled with the ashes of burnt corpses mixed with sand. The colour was a brownish yellow; some were broken, and the fractures showed that coal ashes had been mixed with the clay of which they were made. Some bronze needles were found with them, finished at the top in a semicircular shape. The vessels seem to have been formed on a lathe, and are tolerably smooth, regular in shape, and only slightly baked. The largest were about 30 centimetres in diameter at the widest part, and 26 centimetres high. The ornaments were either triangles or semicircles scratched on the surface with points impressed on the surface. Possibly the site where they were found was a refuge and a place of sacrifice in old German times.

CORAL.—The *Journal de la Chambre de Commerce de Constantinople*, writing of coral, says that it is found in every sea from the equator to the polar regions, but it develops best in the tropical parts of the Pacific, where the temperature of the water never falls below 20 degs. C. The coral of commerce, which is that used for jewellery, is known as *corallum rubrum*, or red coral, and is found in abundance in the Mediterranean, principally off the coast of Italy, in the neighbourhood of Sicily and Messina, off Sardinia, Corsica, and the Balearic Islands, Provence, Catalonia, Morocco, Algiers, and Tunis. It is dark-red on the Barbary coast, yellow on that of Sardinia, and rose on the Italian and Tunisian coasts. The most beautiful rose coral is found especially on the rocks off Galita and Fratelli islands, off the north coast of Tunis. White coral is also met with off Barbary; it is only a variety of the red. Black coral is found in the same place, but this is believed to be merely broken branches under the influence of chemical action. Most of the coral boats are Italian. Fishing is carried on in water of varying depths; but the deeper it is the greater the probability of obtaining valuable coral. Hence it is usual not to fish within a distance of three leagues from the coast. That obtained from a depth of 50 metres is not comparable to that got from 600 metres by means of the dredge. In shallow water there is very little chance of finding the beautiful rose coral, which is said to be worth fifty times its weight in gold. The Italian fishermen take their coral to Leghorn usually, where it is either worked up or sold in its rough state. There are extensive establishments in Leghorn for working coral, the greater part of it being sent to India by way of Marseilles. The export to Europe is inconsiderable, except to Russia and Germany, where some articles in coral are much sought after. The principal markets are Torre-del-Greco, Messina, Naples, and Genoa, in Italy, Bona and La Calle, in Algeria, and Marseilles; but this latter has been shorn of much of its importance by the closing of the factories. But Europe takes an insignificant part of the coral produced; the most important markets are in Central Africa, the East Indies, Japan, and South America. The *débris* of coral after working and setting, beaten to powder and scented, makes a tooth powder which is sold at a considerable price by perfumers. The best rose coral has been sold in Naples at £18 10s. per ounce; but in the rough state, good and bad mixed, it may be obtained from 18s. to 40s. a pound, while choice coral is worth about £12 a pound. But the price naturally varies with the quantity obtained and with the fluctuations of taste.

The Public Health.—The Registrar-General reports that the deaths registered last week in twenty-eight great towns of England and Wales corresponded to an annual rate of 17·5 per 1,000 of their aggregate population. In London 2,508 births and 1,342 deaths were registered. Allowing for increase of population, the births were 135, and the deaths 143 below the average numbers in the corresponding weeks of the last ten years. The annual death-rate per 1,000 from all causes, which had been 18·0, 16·2, and 17·5 in the three preceding weeks, declined again last week to 16·4. During the first nine weeks of the current quarter the death-rate averaged 16·2 per 1,000, and was 4·4 below the mean rate in the corresponding periods of the ten years 1878-87. The 1,342 deaths included 39 from measles, 15 from scarlet fever, 23 from diphtheria, 24 from whooping-cough, 10 from enteric fever, 1 from an undefined form of continued fever, 144 from diarrhœa and dysentery, 2 from cholera and choleraic diarrhœa, and not one from small-pox or typhus; thus 258 deaths were referred to these diseases, being 58 below the corrected average weekly number. No death from small-pox was registered, the corrected average being 7; only 2 small-pox patients were under treatment in the Metropolitan Asylum Hospitals, and 1 in the Highgate Small-pox Hospital, on Saturday last. The 15 deaths from scarlet fever showed a decline of 6 from the number in the previous week, and were 23 below the corrected average; 3 belonged to St. Luke, 3 to Bethnal Green, and 2 to Lambeth sanitary areas. At the end of the week the Metropolitan Asylum and London Fever Hospitals contained 793 scarlet fever patients, against 774 and 783 in the two preceding weeks; 93 cases were admitted during the week, against 66 and 83 in the two previous weeks. The deaths referred to enteric fever, which had been but 2 and 7 in the two preceding weeks, further rose last week to 10, but were 6 below the corrected average; 2 belonged to Islington sanitary area. The Metropolitan Asylum Hospitals contained 73 cases of enteric fever, but none of typhus, on Saturday last; 7 cases of enteric fever were admitted during the week, against 7 and 10 in the two previous weeks. The deaths referred to diseases of the respiratory organs, which had been 167 and 172 in the two preceding weeks, declined last week to 130, and were 45 below the corrected average. Different forms of violence caused 53 deaths; 48 were the result of negligence or accident, among which were 29 from fractures and contusions, 2 from burns and scalds, 8 from drowning, and four of infants under one year of age from suffocation. In Greater London 3,241 births and 1,644 deaths were registered, corresponding to annual rates of 30·6 and 15·5 per 1,000 of the estimated population.

The Effects Produced by Earthquakes upon the Lower Animals.—In the last issue of the "Transactions of the Seismological Society of Japan," Professor Milne, the well-known student of volcanic phenomena, discusses the effects of earthquakes on animals. The records of most great earthquakes refer to the consternation of dogs, horses, cattle, and other domestic animals. Fish also are frequently affected. In the London earthquake of 1749 roach and other fish in a canal showed evident signs of confusion and fright, and sometimes after an earthquake fish rise to the surface dead and dying. During the Tokio earthquake of 1880 cats inside a house ran about trying to escape, foxes barked, and horses tried to kick down the boards confining them to their stables. There can, therefore, be no doubt that animals know something unusual and terrifying is taking place. More interesting than these are the observations showing that animals are agitated just before an earthquake. Ponies have been known to prance about their stalls, pheasants to scream, and frogs to cease croaking suddenly a little time before a shock, as if aware of its coming. The Japanese say that moles show their agitation by burrowing. Geese, pigs, and dogs appear more sensitive in this respect than other animals. After the great Calabrian earthquake it is said that the neighing of a horse, the braying of an ass, or the cackle of a goose, was sufficient to cause the inhabitants to fly from their houses in expectation of a shock. Many birds are said to show their uneasiness before an earthquake by hiding their heads under their wings and behaving in an unusual manner. At the time of the Calabrian shock little fish like sand-eels (*cirricelli*), which are usually buried in the sand, came to the top and were caught in multitudes. In South America certain quadrupeds, such as dogs, cats, and jerboas, are believed by the people to give warning of coming danger by their restlessness; sometimes immense flocks of sea-birds fly inland before an earthquake, as if alarmed by the commencement of some sub-oceanic disturbance. Before the shock of 1835 in Chili all the dogs are said to have escaped from the city of Talcahuano. The explanation offered by Professor Milne of this apparent prescience is that some animals are sensitive to the small tremors which precede nearly all earthquakes. He has himself felt them some seconds before the actual earthquake came. The alarm of intelligent animals would then be the result of their own experience, which has taught them that small tremors are premonitory of movements more alarming. Signs of alarm days before an earthquake are probably accidental; but sometimes in volcanic districts gases have emanated from the ground prior to earthquakes, and have poisoned animals. In one case large numbers of fish were killed in this way in the Tiber, and at Follonica on the morning of April 6, 1874, "the streets and roads were covered with dead rats and mice. In fact, it seemed as if it had rained rats. The only explanation of the phenomena was that these animals had been destroyed by emanations of carbon dioxide."

Natural History.

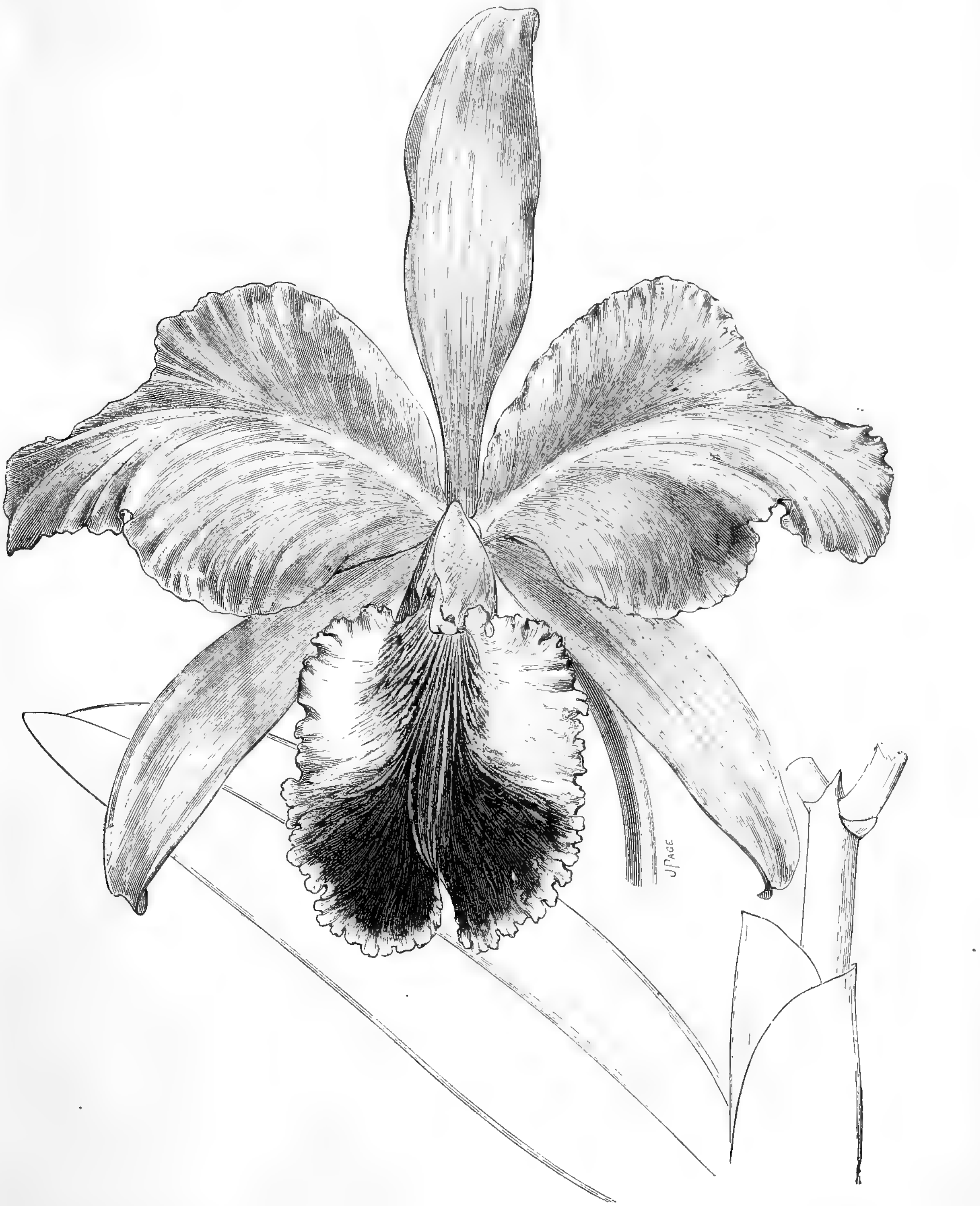
ORCHIDS, WHAT ARE THEY?—III.

(Concluded from p. 60.)

THE genus *Cattleya*, also South American, rivals *Odontoglossum* in beauty, and is equally apt to form artificial, if not natural hybrids. Its favourite centres are three: in Mexico and Guatemala, in that part of South America which stretches across from New Granada to British Guayana, and in Southern Brazil.

The essential characters of Cattleya are: *sepals* free, nearly equal, spreading; *petals* broader than sepals; *lips* attached to the base of column; *column* long, robust, rarely winged, often incurved; *pollinia*, four in two pairs.

Cattleya labiata vera has flowers from five to six inches in diameter, sepals and petals, bright satiny rose, faintly touched with mauve; the anterior lobe of the lip is a rich



CATTLEYA LABIATA VERA (AFTER VEITCH).

magenta colour, bordered with rosy lilac; beneath is a pale yellow blotch, streaked and veined with rosy purple.

The genus *Laelia*, rivalling *Cattleya* in beauty, can be clearly distinguished from it only by the number of the pollinia, which in Cattleya form a single series of four, but in Laelia they form two series of four, eight in all.

From the "cool" orchids of the western hemisphere we pass to their kindred and rivals, the "hot" species of the eastern continent, and especially of India, in the widest sense of the term. Among these three genera are prominent, Dendrobium, Bulbophyllum, and Cirrhopetalum.

Of these the Dendrobia form a kind of parallel to the Epidendra of the west. Each genus comprises hundreds of species or varieties—if these two terms have any clearly distinct meaning. Each displays gorgeous colouration, delicacy, and refined beauty. Some have rod-like stems more than ten feet in height covered with hundreds of flowers. Thus in *Dendrobium fimbriatum* as many as 1,216 flowers have been counted on a single plant.

The Dendrobia extend over a very large portion of the earth's surface, from the Western Himalaya to Australia, Tasmania, New Zealand, and even the islands of the Pacific. Their head-quarters, however, seem to be the Eastern Himalaya and the country stretching from the valley of the Brahmaputra along the eastern side of the Bay of Bengal. In the district of Moulmein alone 43 species sufficiently showy to come under the notice of collectors and horticulturists are recorded. The Philippine Islands produce several fine species, as also does Java. Borneo and New Guinea, considering their extent and their climate, have not sent us hitherto many Dendrobia, or indeed orchids of any type. It is probable that further observation will tell a different tale.

The eastern side of Australia, from Cape York southwards to Cape Howe, yields not a few Dendrobia. As a rule, they require a higher temperature than the South American species. Thus in the lower Himalayan zone the temperature ranges from 80 degs.—90 degs. F. in the summer to perhaps as low as 65 degs. F. in December and January. The atmospheric moisture is abundant; in the Khasia Hills a rainfall of 600 ins. has been registered in one year, and 250 ins. in the month of August alone. It is noticed, however, that in these very moist, hot districts the Dendrobia grow on trees at the height of from 10 to 50 ft., so that they are above the low dense jungle growth, and have the full benefit of the air. A species found in the Andaman Islands flourishes in situations where it is exposed to the spray of the sea. In the hot plains of Moulmein the native Dendrobia are almost baked during the dry season, when they rest, just as the plants of cold climates do in the winter.

Mr. Veitch, to whose courtesy we are indebted for the illustration which we lay before our readers, points out, in his excellent "Manual of Orchidaceous Plants" (SCIENTIFIC NEWS, vol. ii., p. 14), that we can supply orchids, or indeed any tropical plant, with the exact temperature and quantity of moisture which it receives in its native country. But we cannot give it the same amount of light, and that light will fall upon the plants at different angles owing to the lower altitude of the sun. It is certainly possible that this difference may account for the difficulty of cultivating some species under glass. Will the electric light ever make up the deficiency?

The botanical characteristics of the genus Dendrobium are:—*sepals* nearly of equal length, the dorsal one free, the two lateral attached to the foot of the column and forming with it, in some species, a short gibbous skin, in others a longer or shorter spur; *petals* generally of the same length as the sepals, sometimes longer, often broader, rarely narrower; *lip* more or less contracted at base into a claw, lying on or attached to the foot of the column; *column* produced below point of attachment to the ovary into a kind of foot, the portion above ovary being very short; *pollinia*, four in number, of a waxy texture, oval or oblong, compressed and lying parallel within the anther case; *capsule* ovoid, or oval oblong, rarely elongate.

The colouration of the flowers varies greatly: *Dendrobium arachites* is of a uniform vermilion-red, the lip veined with purple. *D. Bensoniæ* is milk-white with an orange disc on the lip, at the base of which are two maroon spots. *D. Boxalli* is white, bordered, and tipped with pale mauve purple; lip yellow, bordered with white, and with a purple blotch on the anterior margin.

The genera *Bulbophyllum* and *Cirrhopetalum* follow closely upon Dendrobium, which they much resemble. Bulbophyllum, however, has a still wider range than Dendrobium. Its head-quarters are in India and the Malay Islands, but it spreads not merely into Australia and New Zealand, but into Africa—especially Sierra Leone—and Central and South America. Seven Brazilian species are known, a very curious fact. Many of the Bulbophyllums have long, rambling rhizomes, and attain gigantic dimensions. *Bulbophyllum Beccari*, one of the most curious, a native of Borneo, entwines the trees like a serpent. Its flowers, spotted yellow and red, are very small, but they form remarkably large, dense clusters. They emit, however, so abominable a scent that the plant is practically excluded from cultivation. What being is this stench to repel, or to attract? The functions of sweetly-smelling flowers have been studied not unsuccessfully, but those of the "stink-worts," if we may so call them, still remain an unsolved problem.

Another interesting question here suggests itself: Why is Africa so poor in orchids, and why are both its fauna and its flora comparatively so monotonous?

A SWALLOW'S NEST IN AN ELM.—In a letter to the *Times*, Mr. J. A. Smith, of Akenham, states that—"A pair of swallows have chosen a novel nesting-place in this parish, having attached their nest to a small elm bough overhanging my fish pond. Yarrell records a similar instance, except that the nest was built upon the forked branch of a sycamore. In the case I now record the nest beautifully harmonises in appearance with the bark of the bough, and the mud used in its construction is well mixed with grass so as to withstand the storms of wind and rain. The nest is well lined with feathers, and to-day the young birds are looking around as if anxious to leave the structure which they have outgrown. What should induce the swallows to leave my dining-room chimney for this novel situation? Possibly they disliked the smoke from a fire rendered necessary this year on a chilly evening in July, or they may have reasoned that the bough was in a convenient situation, the surface of the pond yielding the best supply of insect food in a cold, showery season."

THE FOSSIL TORTOISE OF PERPIGNAN.—In a paper read before the Paris Academy of Sciences, M. P. Fischer shows that this tortoise is a gigantic form of an existing African group *Testudo pardalis*. Its alleged affinities with the modern gigantic tortoises of the Seychelles and the Gallapagos, and with the *Chersites* of Southern Europe have not been established. It may be considered as a relic of a more ancient fauna of an African type.

A New Hypnotic Agent.—According to M. J. Luys, the fascinating effect produced upon larks by a revolving mirror is capable of developing analogous phenomena in the human species, especially in neuropathic subjects of both sexes.

THE INTERNATIONAL GEOLOGICAL CONGRESS.

THE fourth triennial session of this Congress will be held, by permission of the Senate of the University of London, in the University buildings in Burlington Gardens. The first general assembly of the Congress will take place in the theatre of the University at 7.30 o'clock on Monday evening, September 17th, when the inaugural address will be delivered in French by Professor Prestwich, as President, French being the official language of the Congress. At 9 p.m. Professor and Mrs. Prestwich will hold a reception.

On Tuesday morning the Congress will meet at 10 o'clock, when questions bearing upon geological nomenclature and classification will be discussed. A full report on these subjects will be presented by the American Committee. This report, which has been printed in advance, forms a volume of 220 pages, edited by Professor Persifor Frazer. Although written in English, a French abstract has been prepared by Professor Dewalque, the Secretary of the General Committee on Unification of Nomenclature; and copies of this abstract will be distributed at the meeting. The English Committee, under the presidency of Professor T. McK. Hughes, will also present its revised report, which is now being printed, and forms a substantial work.

On Wednesday morning the sitting will be devoted to the discussion of a subject which has of late years excited much attention in geological circles—the nature and origin of the crystalline schists. Special authorities on this subject have been invited to contribute short memoirs which have been printed in advance. As copies of these papers will be distributed to the members, the communications may be taken as read and the time of the meeting occupied only in their discussion. The volumes of papers entitled "Etudes sur les Schistes Crystallins," contains the following communications:—"Les Schistes Cristallins," by Dr. Sterry Hunt; "Zur Klassification der krystallinischen Schiefer," by Professor A. Heim, of Zürich; "Sur la Constitution et la Structure des Massifs de Schistes Cristallins des Alpes Occidentales," by Professor C. Lory, of Grenoble; "Bemerkungen zu einigen neueren Arbeiten über krystallinisch-schiefrigen Gesteine," by Professor J. Lehmann, of Kiel; "Sur l'Origine des Terrains Cristallins Primitifs," by M. Michel-Lévy, of Paris; "The Archæan Geology of the Region North-West of Lake Superior," by Mr. A. C. Lawson, of the Geological Survey of Canada; "On the Crystalline Schists of the United States and their Relations," by various members of the United States Geological Survey; and a paper by Herr K. A. Lossen, of the Geological Survey of Prussia. The group of papers contributed by the United States Survey contains first an "Introduction," by Major J. W. Powell, the Director, followed by a paper on "The Crystalline Schists of the Lake Superior District," by the late Mr. R. D. Irving, and Messrs. T. Chamberlin, and C. R. Van Hise; this is succeeded by a sketch of "The Crystalline Schists of the Coast Ranges of California," by Mr. G. F. Becker, and a brief description of "The Crystalline Rocks of Northern California and Southern Oregon," by Captain C. E. Dutton.

On Wednesday evening the Congress will be received by Dr. A. Geikie, as Director-General of the Geological Survey, at the Museum of Practical Geology in Jermyn Street. With the view of illustrating the subjects that will have been discussed at the morning sitting, it is proposed that during the evening a series of microscopic sections showing the structure of the crystalline schists shall be exhibited on the screen, by means of the lime-light, in the theatre of the Museum.

At 10 o'clock on Thursday morning the Congress will re-assemble in the University theatre, and proceed to the discussion of questions bearing upon the International Map of Europe. A report will be presented by the Map Committee, and specimen sheets illustrating the character of the work. In the afternoon the members will make excursions in various directions. One party will visit Windsor and Eton, where they will be entertained by the masters of Eton College; another party will visit Kew, and be received by Mr. Thiselton Dyer, as Director of the Royal Gardens; other members will go down the river to Erith and Crayford for the purpose of examining the brick-earths and gravels of the Thames valley; while others will probably visit Watford and St. Albans.

On Friday morning the discussion on nomenclature and classification, and on the coloration of maps, will be resumed. In the evening there will be a reception at the rooms of the Geological Society at Burlington House, by Dr. W. T. Blanford, as President of the Society. The concluding business of the Congress, mostly of a formal character, will be taken at Saturday morning's sitting.

Several geological excursions have been organised for the week following the London session. One of these, which promises to be extremely popular, is to the Isle of Wight, under the direction of Messrs. W. Whitaker, J. Starkie Gardner, A. Strahan, and H. Keeping. By invitation of Sir Charles Wilson, this party will also visit the offices of the Ordnance Survey at Southampton. Another interesting excursion is to North Wales under Dr. H. Hicks, assisted by Professor J. H. Blake for Anglesey, and by Mr. G. H. Morton for the carboniferous limestone of Llangollen. A third excursion is planned to East Yorkshire, under the direction of Mr. J. W. Woodall and Mr. C. Fox-Strangways, assisted by Mr. W. H. Hudleston, for some of the oolitic series, Mr. G. H. Lamplugh for the Flamborough chalk, and Mr. Hugh Bell, for the mines and iron-works of Middlesborough. West Yorkshire will also be visited by a party under the guidance of Mr. J. Marr and Mr. R. H. Tiddeman. Finally, an excursion to East Anglia has been organised under Mr. F. W. Harmer (Mayor of Norwich) and Mr. Clement Reid, assisted for the older Pliocence beds of Suffolk, by Dr. J. E. Taylor, of the Ipswich Museum. A guide-book containing geological descriptions of the localities about to be visited, written in French, and illustrated by coloured geological maps has been prepared, and will be presented to the members of the Congress. To this guide-book Mr. Topley has contributed a sketch of the geology of the various railway routes by which foreigners will reach London.

The Official Report of the Berlin Congress has just been issued.

The British Association.

SECTIONAL MEETINGS.

FULL REPORT OF THE DISCUSSIONS.

[FROM OUR OWN REPORTERS.]

MATHEMATICAL AND PHYSICAL SECTION.

(*Continued from p.* 255.)

LIGHT AND ELECTRICITY DEPARTMENT.

SATURDAY, SEPT. 8TH.

Professor G. F. FITZGERALD, F.R.S., presiding.

The first paper was on *The Harmonic Series of Lines in the Spectra of the Elements*, by Professor Dr. CARL RUNGE, who said that Messrs. Liveing and Dewar, in their researches on the ultra violet spectra of elements, had drawn attention to the appearance of what they called the harmonic series of lines. Similar to the formula found by Dr. Balmer, of Zurich, in 1885, for the wave lengths of thirteen lines of hydrogen spectrum, there existed, as Professor Kayser and he (the speaker) had found, formulas for the groups of lines of other elements, which Professors Liveing and Dewar, as he had before observed, had named the "harmonic series of lines." This series of lines had been compared to the series of overtones emitted by a vibrating elastic body. He took the liberty of laying before the section a photographic map of the visible and ultra-violet part of the spectrum of iron. It was meant to serve as an instrument for determining the wave lengths of the lines of other elements, and was going to be copied in phototype and published by the Academy of Berlin, together with the wave lengths of the lines measured by Professor Kayser and himself. The scale on the map was rather inexact, but it sufficed to identify a line so as to be able to look up the wave lengths in the tables. He thought that even the weakest lines had been determined with an exactness of 0·1 Angström's unit, and that the probable error of the sharp ones was less than 0·03 Angström's units.

Dr. J. JANSSEN, a foreign member of the Royal Society, addressed the section in French at considerable length on the *Application de l'Analyse Spectrale à la Mécanique Moléculaire. Spectres de l'Oxygène.* He said he had made observations on the absorption spectrum of oxygen. He found there was a series of lines in the spectrum, the two most prominent of them coinciding with Fraunhofer's A and B. There were also a series of bands, the three most prominent being about 628, 575, 477. He said he had shown that the lines depended on the quantity of oxygen through which the light had passed.

Sir WM. THOMSON, F.R.S., congratulated Dr. Janssen upon his extremely lucid statement. He thought that the French of the Professor would be better understood by members of the Association than would be the English of most of the inhabitants of this island, or, he might add, the English of the neighbouring continent of North America. So important did he consider Professor Janssen's paper, that he proposed that it should be printed at the expense of the Association, and circulated amongst the members.

Dr. GLADSTONE seconded the motion, which was agreed to.

A paper on *The Absorption Spectrum of Oxygen*, written by Professors LIVEING, F.R.S., and DEWAR, F.R.S., was read by Mr. R. T. GLAZEBROOK, M.A., F.R.S., one of the secretaries of the section.

Papers on *A Vortex Analogue of Static Electricity*, and on *A Diffusion Photometer*, were read by Professor W. M. HICKS, F.R.S., and Mr. J. JOLY respectively, and votes of thanks were passed to those gentlemen.

The *Report of the Committee on Electrolysis* was then read. This we may give in some future issue.

DEPARTMENT OF MATHEMATICS AND GENERAL PHYSICS.

Professor EVERETT, M.A., D.C.L., F.R.S., etc., presiding.

Papers by Professor R. W. Genese, on *Centres of Finite Twist and Stretch*, and on *Recurring Decimals and Fermat's Theorem*, were read, for which the author received the thanks of the meeting.

The PRESIDENT then read a paper on *The Relation between Orbits, Catenaries, and Curved Rays.* Professor A. M. WORTHINGTON, in dealing with *The Tensional Stress and Strain within a Liquid*, described the three methods that have been employed by previous observers to subject a liquid to tension. These are :—

(1) *The barometer tube method*, by which Professor Osborne Reynolds had succeeded in subjecting mercury to a tension of five or six atmospheres due to its own weight.

(2) *The centrifugal method*, devised by the same observer, and by means of which he had subjected water to a pull of about five atmospheres (72·5 lbs. per square inch); while the author had succeeded in reaching with alcohol a tension of 7·9 atmospheres, or 116 lbs. per square inch, and with strong sulphuric acid a tension of 11·8 atmospheres, or 173·4 lbs. per square inch.

(3) *The method of cooling*, discovered by Berthelot, and described by him, "Ann. de Chimie" xxx. (1852): Sur la dilatation forcée des liquides.

The author then described the form of apparatus, arrived at after many trials, by which the tension of the liquid and the extension produced by it could be simultaneously measured.

The experimental proof that tensional stress within a mass of liquid is necessarily accompanied by a corresponding strain, was, in the author's opinion, an important point in the theory of surface tension, since it showed that the diminution of density or extension of the surface liquid, which could be shown to be a necessity of the equilibrium at the surface, was sufficient to account for the surface being a seat of energy. It became, in fact, unnecessary to ascribe to the energy any other form than that in which it existed in stretched matter.

Professor HELE SHAW, M.Inst.C.E., then gave an address on a *New Sphere Planimeter.*

MONDAY, SEPTEMBER 10TH.

Mr. WM. ESSON, M.A., F.R.S., presiding.

Mr. R. T. GLAZEBROOK, M.A., one of the Secretaries, laid before the section the fourth report of the Committee, consisting of Professor Balfour Stewart (Secretary), Professor W. Grylls Adams, Mr. W. Lant Carpenter, Mr. C. H. Carpmael, Mr. W. H. Christie (Astronomer Royal), Professor G. Chrystal, Captain Creak, Professor G. H. Darwin, Mr. William Ellis, Sir J. H. Lefroy, Professor S. J. Perry, Professor Schuster, Professor Sir W. Thomson, and Mr. G. M. Whipple, appointed for the purpose of considering *the Best Means of Comparing and Reducing Magnetic Observations.*

He said since their last report the Committee have to record the death of their Secretary, Professor Balfour Stewart, whose loss will be deeply felt in the scientific world, especially by those who are engaged in researches in terrestrial magnetism and in the work of magnetic observatories. A meeting of the Committee was held on February 2nd, 1888, at which Professor W. Grylls Adams was requested to act as Secretary to the Committee and to forward to the directors of magnetic observatories copies of the third report of the Committee, calling special attention to the paragraphs relating to the determination of scale co-efficients.

At the second meeting of the Committee, on July 11th, 1888, Mr. W. L. Carpenter handed to the Committee a paper which had been prepared by Professor Balfour Stewart, on a comparison between the wind values and declination disturbances at the Kew Observatory. The Committee have thought it right to recommend that this paper and the table accompanying it be printed as an appendix to the report.

The Committee learn that all the scientific material found among Dr. Stewart's papers is in the possession of Professor A. Schuster. Professor Schuster has continued his reduction of the diurnal variation of terrestrial magnetism, and has nearly completed a paper on the subject, which he proposes to present to the Royal Society.

A paper has also been communicated to the Committee by Major Dawson, on magnetic observations taken at Fort Rae in 1882-83.

The Hon. RALPH ABERCROMBY read a paper on *Modern Views about Hurricanes, as Compared with the Older Theories.* He said the old idea of a hurricane was that of a circular-shaped eddy, round which the wind blew in circles; the whole system was not supposed to be connected with any surrounding trade-wind or monsoon, and the idea that a hurricane changes its shape, as well as its depth and intensity, during its progress, was never thought of.

Modern research showed that a hurricane was really an oval eddy, and that the vortex, or centre of the wind rotation, was not in the geometrical centre of the oval, but usually nearer one edge or other of the depression. The former was a very simple, the latter a very difficult conception; nevertheless, such were the facts, as the author has proved by an examination of hurricanes on sixty different days.

The wind blew as a spiral of variable incurvature round the vortex, not round the centre of the oval. The general sense of the rotation was counter-clockwise in the Northern, clockwise in the Southern Hemisphere; but the amount of incurvature varied in different parts of the oval, for a number of reasons. As a rule, in all hurricanes the incurvature was less in front than in rear of the vortex.

A hurricane was also always changing its shape, so that the oval lay sometimes in one way, and sometimes quite in a different direction; while sometimes the vortex was displaced towards one side of the oval one day, and towards quite another side on the next.

The path of the hurricane was not in a regular line, for the vortex sways about, and sometimes even described a loop.

For all these reasons, no rule was possible for determining absolutely the bearing of the vortex by observations on board a single ship, whereas it used to be stated positively that facing the wind the vortex bore 8 points—at right angles—to the right in the Northern, and to the left in the Southern Hemisphere.

It can only be said now that, when fairly within the storm-field and facing the wind, the vortex will be to the right and a little to the rear—that was, from 8 to 12 points to the right of the wind—in the Northern Hemisphere, and to the left and a little to the rear—that was, from 8 to 12 points to the left of the wind—in the Southern Hemisphere. If the wind blew exactly in a circle round a circular hurricane the vortex would always bear 8 points to the right or left according to the hemisphere, and the rule to take 8 to 12 points is simply allowing for the effects of variable incurvature.

The above rule does very well for a first approximation to the bearing of the vortex, but greater precision can be attained in certain circumstances. If the condition indicated that a ship was nearly in front of the vortex the bearing of the vortex will probably not be much more than 8 points to the right or left, according to the hemisphere, because, as before mentioned, the incurvature was very small in front of a hurricane. Great care must be taken not to apply this rule to an increasing trade with a falling barometer, as will be explained hereafter.

In the rear of a hurricane, on the contrary, the vortex might bear 12 or even more points to the right or left of the wind, because the wind was very much incurved in that part of a hurricane. A ship should therefore always then lie-to till the barometer began to rise and the weather to improve, otherwise she would probably run right into the vortex. She might easily scud 10 knots, while the hurricane might not be advancing more than 5 miles an hour, so that it was very easy to catch up the vortex. The discovery of this great incurvature is one of the most important modern developments of the subject.

It used to be thought that if the wind increased in force, without changing in direction, with a falling barometer, a ship must necessarily be in the line of progression of the vortex, and that she should run at once. This was owing to the idea that a hurricane was an isolated disturbance.

Now we know that if it be only the usual trade-wind, which increases without changing in direction, and with a falling barometer, a ship should lie-to till the mercury has fallen at least 6·10ths of an inch before she runs as a last resource. Modern research had proved that a hurricane is usually embedded in some prevailing trade or monsoon, and that there was therefore a belt of intensified trade-wind outside the true storm-field. This belt was always on the side of the hurricane farthest from the equator. A ship in this belt experienced an increasing trade without change of direction, and with a falling barometer, though she might be far away from the line of progression of the vortex. She would equally experience an increasing and unchanging wind, with a falling barometer, if she were in the line of progression; but as there was no means of knowing whether she was in the line of progression or only in the belt of intensified trade, the empirical rule says, "Lie-to till the mercury has fallen 6-tenths of an inch before beginning to run."

The old rules for finding which semicircle of a hurricane a ship may be in, and the old rules for heaving-to in either hemisphere, are all proved to be both true and valuable by modern research. These rules remain as follows: Facing the wind in both hemispheres, if the wind changes by the right the ship is in the right-hand semicircle, and she should heave-to on the starboard tack; if the wind changes by the left she is in the left semicircle, and should heave-to on the port tack. If circumstances compel her to run she should keep the wind well on the starboard quarter in the North Hemisphere, and well on the port quarter in the South Hemisphere.

It is much to be regretted that the examination-papers of the Board of Trade for master and mates are painfully behind the modern standards of knowledge, and that in these matters the Germans and other nations are now ahead of England. The whole knowledge which is required in our merchant service is contained in six questions, and a candidate is expected to say that the centre bears 8 points, or perhaps a little more, from the direction of the wind, while no notice is taken either of the small incurvature in front or of the great incurvature in rear, or of the belt of intensified trade, where the usual indications of being exactly in front of the vortex fail.

No one should blame the master of a ship for not following the established rules, without the closest investigation, for, as Piddington says, "absolute rules are all nonsense," and much depends on the capabilities of a ship and on the ever-varying conditions of a heavy cross sea.

Professor DOUGLAS ARCHIBALD felt that many vessels had been lost through following strictly antiquated rules. Seamen were rather conservative, and liked to stick to their old rules, but he was of opinion that the sooner the results of modern observation were adopted the better it would be all round. He was sorry that M. Faye and those who thought with him were not present to hear Mr. Abercromby's paper, because he thought they would have found it rather hard to say, in the face of that paper, that there was no such thing as an elliptical hurricane.

Dr. W. H. RUSSELL desired to ask a question as to the rotatory action of winds. He saw a number of new faces on the platform, and he wished to inquire, therefore, if any one could explain why it was that winds were so frequently rotatory in their motion.

Mr. W. N. SHAW, M.A., one of the Secretaries of the section, explained what he considered was the cause of hurricanes having a circular motion. His argument tended to show that rotatory winds were caused by rushes of hot air from one quarter meeting rushes of cold wind from an opposite direction, which caused the rotatory motion the last speaker had inquired about.

Dr. H. R. MILL then read the report of the Committee on *The Surface Temperature of Water*, and followed it up by a paper on *The Temperature of some Scottish Rivers*.

Professor C. G. KNOTT discoursed on *The Recent Magnetic Survey of Japan*. He observed that, generally speaking, the magnetic features of Japan present great irregularities—a fact which the highly volcanic condition of the country would lead us to expect. The south-western portion of the main island, with the adjacent islands fringing the inland sea, presents fairly uniform magnetic features. The regions where the greatest disturbances exist are (1) the great central mountain region to the north and north-west of Fujiyama, and (2) the region included between the 38th and 40th parallels of latitude.

The general characteristics of the iso-magnetic lines corresponding to the observations made are as follows: The lines of equal dip, of equal horizontal force, and of equal total force are approximately straight, while the lines of equal declination are distinctly parabolic or hyperbolic, approximating very closely to the general form of the main island.

The full details of the survey are given in the second volume of the "Journal of the College of Science, Imperial University, Japan," where also will be found the charts, of which the large charts now shown were rough copies.

Mr. J. JOLY lectured on *Reading Electrically Meteorological Instruments Distant from the Observer*.

Mr. W. N. SHAW, in the absence of Professor G. H. DARWIN, F.R.S., put before the section the paper of the latter on *The Mechanical Condition of a Swarm of Meteorites*, and *on theories of cosmogony*, and then read his own communication on *Some Charts of Kew Corrections for Mercury Thermometers*.

The Committee upon *Standard Lights* submitted their final report upon this subject. In the course of a lengthy document the Committee stated that they had experimented upon ordinary candles, upon sperm candles (six to the pound), with pentane standard lights, and also with the pentane lamp, and with the amyl-acetate lamp. As the result of the experiments the Committee considered that the standard candle, as defined by Act of Parliament, was not worthy of the present state of science, and they gave their opinion in favour of an alteration of the law with regard to standard lights and the adoption of the pentane standard. They further recommended that it should be urged upon the Board of Trade that legislative action should be taken, with a view to speedily bringing about the change suggested in the report.

Mr. WM. SHAW read a paper on *An Apparatus for Determining the Temperature by the Variation of Electrical Resistance*.

TUESDAY, SEPTEMBER 11TH.

Professor FITZGERALD presiding.

There was a very large attendance, Section "G" joining with Section "A" to carry on a discussion on

LIGHTNING-CONDUCTORS.

Mr. W. H. PREECE, F.R.S., opened the debate. He said that it was a most remarkable thing that if we wanted to know much about atmospheric electricity we had to go back to the days and works of Benjamin Franklin, a hundred and forty years ago. Up to 1878 there were absolutely no rules for the guidance of people who desired to erect lightning-conductors for the protection of their houses. In that year a great conference was held on the subject, and the result of its deliberations was published in a book, and included a set of rules for the construction of conductors. He had under his personal observation no less than 500,000 lightning-conductors. Some time ago a lectureship was founded in memory of Dr. Mann, who had experimented on the protection of buildings from lightning in South Africa. Professor Oliver Lodge was selected as the lecturer, but instead of cracking up the work of the Conference, he took the other line, and if his statements were true, lightning-conductors would be of no use, and no buildings would be safe in a thunderstorm. Professor Oliver Lodge had committed himself to fallacies which it was now his (the speaker's) duty to bring before the meeting. The professor assumed that a lightning-rod formed part of the flash. Well, as a matter of fact, it did not. Nobody had ever seen a flash of lightning strike a conductor. The function of the conductor was to prevent the possibility of the building on which it was erected being struck by the flash of electricity. If a building was struck there was some defect in the construction of the conductor. Lightning did not go careering wildly about, but passed along a path prepared for it. There was another fallacy which prevailed, and that was that a flash of lightning was instantaneous. No proof, so far, had been produced of that. They saw a flash of light which indicated part of the discharge, but how long that discharge lasted they did not know. There were invisible flashes of lightning, which was proved by the fact that persons had been killed under trees when there was no visible flash. He had, however, come to the conclusion, by the effect on telegraph wires, when there were currents of sensible duration, that the flash was not instantaneous. He argued that if Professor Lodge were correct no lightning-conductor could protect, and no discharge could possibly be led to the earth. The assertion of the oscillatory character of the lightning flash was based more on mathematical reasoning than it was upon absolute observation. There were those amongst mathematicians who made mathematics their slaves, and when they got into the slough of despond they found it difficult to get out again. Engineers had no great respect for mere mathematical development, unless it was proved by absolute experiment. Mathematical developments should be received with extreme caution, and the theory, beautiful as it was, must, as he had before remarked, be received with great circumspection. There were several facts against the proposition. As to the theory of self-induction there was also much doubt. There was no doubt that Professor Lodge had started a new and fresh hare which electricians must hunt up and kill. Professor Lodge was on the brink of a great discovery, although he (the speaker) did not accept his theory of self-induction. Whatever the result of the present conference was, he would certainly have the advantage of bringing to the front what they were all anxious to see—namely, the true theory of electricity shadowed forth by Professor FitzGerald in his address, which would mark the present meeting of the Association as an important epoch upon that subject.

Professor OLIVER LODGE, F.R.S., said he had had nothing like the experience of Mr. Preece. So far from having half a million lightning-conductors under his supervision, he had not got a solitary one. He had frequently asked his friends to put up conductors on their houses, but the answer he invariably received was that conductors were too expensive, and "it was cheaper to insure." It was perfectly true, as Professor Preece had said, that few public buildings were effectively protected from lightning, the reason being that the conductors used were not efficient. If conductors were used on all lofty buildings, their price would probably be as many shillings as they now cost pounds to put up, and the result would be a great saving to life and property. Mr. Preece had said that a properly constructed conductor had never failed to do its work, but he (the speaker) could not quite agree with that statement, for he thought that lightning-conductors had frequently failed to act when they were called upon to do so. The Hôtel de Ville at Brussels was supposed to be protected from lightning by innumerable conductors, but nevertheless on the 1st of June last year it was struck by the electric fluid and set on fire. The lightning-rod had two functions—one was to act as a point to attract the flash, and the other was to carry off the fluid. It was not desirable that conductors should immediately take the fluid to the earth, for it was often better to allow the great energy of the flash to slowly exhaust itself. He thought the address they had listened to was a very interesting one, and he considered that the thanks of the section ought to be accorded to Mr. Preece for his lecture.

The Hon. R. ABERCROMBY, who followed, produced a number of photographs of lightning flashes. He felt sure good would result from the discussion.

Lord RAYLEIGH observed that whatever might be the failings of mathematicians, he felt that scientists must go to them eventually.

Sir WILLIAM THOMSON, F.R.S., could not help thinking it would be well for the Professor to continue his experiments in regard to the superiority of iron over copper rods. As to protecting buildings, he must confess that it was rather disturbing to find that lightning-rods had so little protecting power. Before, however, iron was generally recommended for lightning-rods, further experiments must be carried out with regard to the conducting power of that metal.

Professors FORBES and ROWLAND (of John's Hopkins College, U.S.A.) and M. de F. FONVIELLE (of Paris) continued the discussion, which, after a few observations from Mr. SYDNEY WALKER, Mr. BROWN, and Mr. WOOD, followed.

Dr. J. JANSSEN, a foreign member of the Royal Society, read a paper on *Analyse Chrcnometrique des Phénomenes Electriques Lumineux*, and Mr. R. T. GLAZEBROOK, F.R.S., discussed *the Standard of Electrical Re istance.*

CHEMICAL SECTION.

(*Continued from p.* 257.)

SATURDAY, SEPTEMBER 8TH.

Professor TILDEN, F.R.S., presiding.

The first business was to receive the report drawn up by Professor Dunstan of the committee appointed for the purpose of inquiring into and reporting on *The Present Methods of Teaching Chemistry.* This was a very long and important report, which we shall probably give *in extenso* in a future issue.

The PRESIDENT said he should like to offer a single criticism on the foregoing report. If, as appeared to be admitted by everybody, chemistry was such a valuable element in school education, surely those advantages should be shared by girls. It was a very extraordinary circumstance, but he did not notice a single reply from a girls' school embodied in the report. It was a regrettable fact that chemistry did not at present seem to have found its way into girls' schools, and he could not help but regard it as a serious misfortune in the interests of the higher education of women. The report, in brief, confirmed the view expressed in his address, that until they had teachers better qualified to impart instruction, these difficulties would not be overcome practically.

The Rev. A. IRVING, in a paper on *Chemistry as a School Subject*, said that chemistry could not properly be taught apart from physics; there was a physical side to every phenomenon. Lecture work should precede laboratory work, and continue *pari passu* with it. Analysis rationally, not mechanically taught, was an excellent mental training. The two should be closely correlated; exercises should be given in the laboratory, preparatory to or suggested by the subjects treated in the lectures, and facts learnt in the laboratory should be turned to account in the lectures. The teacher must not be trammelled by text-books; these must be his instruments, not his masters. Quantitative treatment of subjects in the lectures should be introduced as far as possible from the first, and as pupils advanced they should be trained individually in the use of the balance. Numerical exercises based on (not as a substitute for) lecture demonstration helped to give fixity and precision to ideas. Pupils should be trained to think out, in their note-books, the connection between experimental demonstration and theory, and not have notes dictated to them to be committed to memory. Their knowledge should also be tested by frequent short exmination papers.

Mr. ANGEL (Manchester), in opening the discussion, strongly criticised the system of teaching boys chemistry by mere lectures and note-taking. Such a method, he declared, involved utterly incompatible processes being set up in the juvenile mind. It engendered no scientific thought, and left no clear impression of any phenomena on the mind. The result was entire failure. In nine cases out of ten such a method of teaching made clear scientific thought an impossibility. With regard to examinations, he held that the present progress of science was more due to our system of examination than anything else.

Mr. GATEHOUSE (Bath) thought the report of the Committee in some of its phases confounded the making of the intelligent man with the making of the chemist.

Miss LYDIA BECKER thought the Committee would do well to entirely eliminate from their report the word boy, and substitute for it pupil, student, or child. There were very many difficulties in the way of girls sharing in the benefits to be derived from the study of chemistry and physical science; and there could be no doubt that it was owing to such causes as these that the higher education of women had not made more rapid progress. As regarded the mode of teaching, she thought the habit of questioning pupils was one that should not be practised without more thought. Too often teachers persisted in putting tormenting questions to their pupils. Teachers should impart their knowledge in such a simple, intelligent, direct, and straightforward manner so as to at once produce an impression on the youthful mind. The questions should come from the pupil, and not from the teacher.

Mr. WEST (Bournemouth) thought it was not much good trying to give definite scientific teaching to boys before they were of the public school age.

Mr. LASCELLES, Chemical Master at Harrow, considered the lecture system interspersed with catechism the best. He did not, however, recommend the abstract teaching of chemistry to boys; he believed in imparting to them general facts.

Mr. HUGH MADAN (Exeter), Mr. HARVEY HICHEN (Radley), Mr. VELEY (Oxford), also took part in the discussion.

The PRESIDENT, in adjourning the sitting, expressed a hope that by another year the Committee would be in possession of some definite recommendations to be submitted to the head masters of the great public schools throughout the country.

MONDAY, SEPTEMBER 10TH.

Professor TILDEN, F.R.S., presiding.

Professor H. E. ARMSTRONG, F.R.S., opened a discussion on *Valency*. He said: This was undoubtedly one of the most important and at the same time most difficult problems chemists have to solve. It was clear of course to every chemist that the determination of valency in any particular element involved the constitution of that element. And of course the determination of the constitution involved the idea of valency. The problem presented the greatest difficulties, and all people who were not blind followers of any particular system must admit that in regard to it chemists have yet a great deal to learn. The meaning of the term chemical action must be largely extended, and chemists would have ultimately to regard the physical action involved in the changes as essentially chemical in their nature. Chemical action must be defined as a change in the molecular condition. No doubt chemists had got too much in the habit of treating the nature of chemical affinity from too narrow a point of view. A very considerable widening of our conception in this regard must be insisted upon. There were two forms of valency to be looked at—fixed valency and variable. And he would point out that the only definite conception of valency was practically that which involved the acceptation of the doctrine of fixed valency. But before they could come to any definite conclusion on the subject there must be a greater interchange of opinion between chemists and physicists. It was practically hopeless for the chemists to endeavour to solve the problem by themselves. And one of the greatest difficulties that surrounded the question was the difficulty in putting the chemists' investigations in such a form as to be perfectly intelligible to those outside the circle. Dr. Williamson had advocated the view that in a large number of double salts we were to assume that there was a redistribution of the constituent elements, so that the constituent elements all become associated with one central element. The doctrine of fixed valency assumed that the elements in a great many cases are of a different order, and that in a compound there is no sacrifice of the original substances, but that they are still present. The assumption is that there are the constituent radicals of the compound, and that they are held together in a special way by the mere juxtaposition of the molecules. The great question to decide upon was in relation to the existence of these two classes of compounds. It involved the distinction between atomic and molecular compounds, and that led up to the question, In what manner are the constituent radicals of the molecular compounds held together? One view he particularly desired to advance was one which involved what might be termed the property of supervalency in certain elements. Valency might be described as the atom-fixing power of an element—the power of associating distinct elements in a single atom. Unless they admitted this, the problem must be given up; from this point of view a chlorine was a super-valent element, and they must admit that the chlorine atom was capable of entering into association with more than one other atom. He did not think, however, that mere discussion would help them much, and until they agreed upon some definite line of going to work, the problem would be as far from solution as ever.

The PRESIDENT, in the course of a few remarks, said: Of course, neither Professor Armstrong nor any one else could expect that every chemist would agree with him in all the views he took, but he should like to say how fully he agreed with him with regard to the statement that it was impossible to give any exact definition of chemical action, or indeed of a chemical compound. The discussion of the question of valency peculiarly involved the theory of what is chemical action or chemical combination. One important omission in Dr. Armstrong's argument was the fact that chemical combinations depended almost entirely on the temperature.

Professor A. W. WILLIAMSON, F.R.S., said: Chemists well knew that it was but comparatively recently that their attention had been drawn to the fact that there were atoms which differed from others in the complexity of the group they held together, the power of uniting together various atoms and combining them being possessed in a very different degree. Naturally chemists had made various attempts to explain these phenomena, but, unfortunately, in many cases it had only been a case of putting on intellectual blinkers to shade the horizon so as to limit the view to the particular portion in regard to which pet theories existed. A remarkable instance of variable valency was afforded by nitrogen, which was found in chemical compounds with three and sometimes with five monads. And the important fact must not be lost sight of that in proportion as the temperature was raised did they find the power of holding many atoms in combination diminish. There were two classes of compounds which had different valencies, and one class was quite as characteristic of compounds in the same degree as the other. Nothing but phrases could be used to establish a distinction between them. With regard to some other points which claimed very special attention, they could not fail to notice that the bodies in which many atoms were found grouped together chemically were of rare occurrence. The changes of temperature ought to be particularly noted, in that it diminished the power of the one central atom. But before they made progress with so complex and difficult a subject they must proceed on the clear statements of ascertained facts, and with as little supposition as possible.

Lord RAYLEIGH, Sec.R.S., said it was a very wide question that had been touched upon as to how far it was desirable to introduce new names for expressing physical or chemical results. He thought that both advantages and disadvantages would be experienced. No doubt it would please physicists if every element could be determined as having a fixed valency. He, however, failed to see how they could get over such phenomena as that afforded in ammonium chloride.

Dr. GLADSTONE, F.R.S., suggested that the refraction and dispersion of bodies was an object that would bear largely upon the consideration of some of the difficult questions that had been brought forward. It ought to be a most powerful argument in explaining some of the peculiarities of combination. Physical phenomena and chemical facts sometimes agreed, and he thought they would have to note this relationship more definitely before they came to complete agreement on so complex and difficult a subject.

Professor STERRY HUNT said he had maintained for years that all changes, such as condensation, etc., and those remarked upon by Dr. Gladstone, were essentially changes in their nature, and that in the case of chemical combination it was nothing more than a disposition which all matter had to unite and condense—the tendency to intrinsic condensation.

Dr. MORLEY and other members having spoken on the subject, Professor ARMSTRONG briefly replied.

The other papers read were as under:—

Evidence of the Quantivalence of Oxygen, derived from the Study of the Azo-Naphthol Compounds. By Professor R. MELDOLA, F.R.S.

Theory of Solution. Professor STERRY HUNT.

The Composition of Copper-tin Alloys. Mr. A. P. LAURIE, F.C.S.

Analysis of Ancient Mortar from the Roman Wall of London. Mr. S. SPILLER, F.C.S.

Action of Acids on Copper. Mr. V. H. VELEY, F.C.S.

Recovery of Ammonia and Chlorine in the Ammonia-soda Process. Mr. FRED. BALE.

TUESDAY, SEPTEMBER 11.

Professor TILDEN, F.R.S., presiding.

After the report of the Committee on *Isometric Naphthalene Derivatives* had been received from Professor ARMSTRONG, Dr. J. H. GLADSTONE read some *Notes on the Molecular Weight of Caoutchouc and other Colloids*, and Professor EMERSON REYNOLDS described *the Properties of some New Silicon and Thiocarbamide Compounds and the method he had followed in obtaining the same.*

In a paper on *The Action of Light on Water-colours* Dr. RICHARDSON discussed the effect of light on colours, and drew attention to the very important part played by moisture in assisting their decomposition. Colours he divided into two groups: those that bleach by oxidation under the combined influence of light, air, and moisture; and those on which light exerts a reducing action which is independent of the air, and in some cases takes place in the absence of moisture. The author condemned as unsafe those pigments which fade in dry air, and showed that the greater number of paints are stable in sunlight, provided moisture is absent.

Professor T. W. LANGLEY read a paper on *Proposed International Standards of Iron and Steel,* in which he showed the necessity for identical standards being adopted in every country, so that the different productions might be assured of an absolutely uniform material.

GEOLOGICAL SECTION.

(*Continued from p.* 262.)

SATURDAY, SEPTEMBER 8TH.

Professor BOYD DAWKINS, M.A., F.R.S., presiding.

Professor O. C. MARSH, of Newhaven, U.S.A., gave a long address *On the Dinosauria of Europe and America,* explaining them by means of diagrams, and entering into a comparison of the principal forms.

The PRESIDENT said Professor Marsh had laboured in America under more advantageous circumstances than they did in Europe. Here there were only isolated fragments of these difficult creatures, but in the great Continent from which Professor Marsh came they had nearly perfect skeletons; and he certainly welcomed the communication they had had, not merely on account of the addition it made to their knowledge, but also for the prospect which it afforded that they might have some of the long names attached to some of the fragments on this side of the water knocked on the head.

Mr. H. F. OSBORN, Professor of Comparative Anatomy at Princeton, explained a number of diagrams intended to illustrate the *Evolution of the Mammalian Molar Teeth to and from the Tritubercular Type.* He showed that the placental mammalia of the present day have passed through a stage in which the superior and inferior molars presented in the upper and lower jaws three component cusps, and from the molars of this type have been derived the various types of molars among the living mammalia. This tritubercular type, discovered by Professor Cope in the lower Eocene Rocks of North America is shown to have been derived from the molars of the mammals of the Jurassic period, and the latter bear evidence of their descent from the single reptilian cone. The formation of these complicated teeth from the simple teeth may be attributed to the mechanical effect of the interference of the upper and lower molars in the vertical and horizontal motions of the jaws.

Professor H. G. SEELEY objected to the classification of the group alluded to, but beyond this there was no discussion.

Professor GAUDRY (Paris) gave a short note *On the Gigantic Size of certain Fossil Mammalia.* He instanced the skeleton of *Elephas meridionalis* of the Paris Museum, which is nearly five yards high, and said he had himself obtained from Greece a still larger animal —the Deinotherium. (*See p.* 278.)

The PRESIDENT said they were exceedingly obliged to Professor Gaudry for bringing these interesting facts before them. It was well to know that at all events the ancestors of some of the larger mammalia were the larger the further they went back. The Deinotherium stood at the head of the list, and then there was a gradual decrease in the size down to the present.

Professor G. A. LEBOUR, M.A., read a *Note on the Relation of the Percentage of Carbonic Acid in the Atmosphere to the Life and Growth of Plants,* written by the Rev. A. IRVING, D.Sc., B.A., F.C.S., in which the author referred to the discussion raised recently on this question in the pages of the *Geological Magazine.* In order to test the hypothesis adopted by Professor Prestwich, three series of observations had been made during the past summer on plants exposed, under similar physical conditions, to atmospheres of different compositions. The evidence obtained all pointed in one direction, and went to show that, with an increase of the percentage of carbonic acid up to about that of the free oxygen present, the vigour of plant life and growth is also increased, so long as the plants are freely supplied at their roots with water, as we have good reason to suppose was the case with the vascular cryptogams from which the carbonised materials of the coal-measures are for the most part derived. The author further considered the theory as throwing some light upon a certain stage of development of life upon the earth in later palæozoic time; the great development of plant growth in the carboniferous age, having served as the means of storage of carbon in the earth's lithosphere, and thus purified the atmosphere so as to render it fit for the development of air-breathing forms of life in the Mesozoic Age.

Dr. STERRY HUNT considered that the amount of carbonic acid now condensed in vegetation was not entirely due to the purification of impure atmosphere, but that it derived it from an extra-terrestrial source. They must go back to the idea first enunciated by Newton —that there had been a constant interchange between our atmosphere and the atmosphere of other bodies in space.

Professor SEELEY pointed out that nowhere when carbonic acid was given off by the burning of lime did they find any very vigorous vegetable growth. In the neighbourhood of lime kilns they did not find that excessive amount of vegetation they would anticipate on the theory of luxuriant growth during the carboniferous period.

Professor LEBOUR, in the absence of Mr. JAMES SPENCER, read a paper written by the latter on *The Occurrence of a Boulder of Granitoid Gneiss or Gneissoid Granite in the Halifax Hard-bed Coal.*

Professor LEBOUR said it was nothing new to find boulders of gneiss in coal. He knew of many.

Mr. W. WHITAKER (now occupying the chair) agreed with this, and said boulders were so common in the Manchester coal-field, that the Manchester Geological Society had published a series of papers on the subject with illustrations—not only the gneiss, but a great variety of rocks occurred. The boulders also occurred in Germany, and indeed anywhere where they took the trouble to look for them.

Professor CLAYPOLE said there were also many in the United States.

The next paper read was on *The Caverns of Luray,* the author being the Chevalier R. E. REYNOLDS (Washington, U.S.A.).

These famous caverns are situated near the crest of a limestone hill of Silurian Limestone, near Luray Court House, in the valley of the South Shenandoah, Virginia, U.S.A. The valley is bounded on the east by the Blue Ridge Mountains, and on the west by the Massanulton range, the caverns lying equidistant from each. They were discovered in 1880, during which year the Smithsonian Institution sent out a scientific commission for the purpose of exploring and reporting on the same. The writer was a member of this commission.

The caverns—several distinct ones united by engineering operations—are similar to others found in limestone regions. They are mostly the result of erosion; one only—the Ramble, a plateau of 500 feet long by 300 wide—resulting from displacement of the adjacent strata.

Human remains have been found, but the character of their environment proves them to be of Indian origin. From the depth of the travertine which enclose them they appear to have been imprisoned for nearly a thousand years. The bones that are now visible consist of the right femur, the lower jaw, a rib, the segment of a clavicle, and a few teeth detached from the superior max. They appear to have belonged to a female of seventeen or eighteen years, the sex and age being determined by anatomical structure, ossification, and dentition.

The writer's memoir on this subject embraced a vast amount of information on the early or incipient growth of stalactites, some of which is believed to be wholly original. He is also engaged in studying the ratio of stalagmitic growth in the Atlantic coast caverns. The result now obtained shows that the vertical growth of stalagmite is one inch in forty years. The growth of stalactites is nearly twice as fast, or one inch in twenty years.

Mr. W. TOPLEY, F.R.S. (Recorder), presented a report on *The Rate of Erosion of the Sea Coasts of England and Wales.*

MONDAY, SEPTEMBER 10TH.

VOLCANIC DEPARTMENT.

Professor BOYD DAWKINS, F.R.S., presiding.

Dr. TEMPEST ANDERSON, B.Sc., exhibited a number of photographs (by the aid of Mr. Pumphrey and lime-light) of *the Volcanoes of the two Sicilies.* The exhibitor has recently visited the volcanoes of Naples, the Lipari Islands and Sicily, including Vesuvius, Stromboli, Vulcano, and Ætna, and taken photographs of their craters, and some of their lava streams, and other most important parts, in order to obtain a record of their present condition which may be available for comparison in case of future eruptions.

Dr. H. J. JOHNSTON-LAVIS contributed, in combination with this lecture, voluminous *Notes on the Formation and Geological History of Volcanoes.*

Accompanying it was a graphic account of the eruption of August last by Mr. A. E. NARLIEN, who was on the island at the time, an account, said the lecturer, which was well worthy from its analogy of being placed side by side with the renowned epistle of Pliny the younger to Tacitus.

Dr. H. J. JOHNSTON-LAVIS followed with a *Report on the Volcanic Phenomena of Vesuvius,* which we may publish in a future issue.

Dr. JOHNSTON-LAVIS then read a paper on the subject of *The Conservation of Heat in Volcanic Chimneys.* He said: One who daily follows the phenomena of an active volcano such as Stromboli, Vesuvius, and others of the same type, cannot but be struck with the fact that the enormous evolution of watery and other vapours does not suffice to reduce the temperature of the magma to the point of solidification.

By carefully following the details of the varying activity of the above-mentioned volcanos, which we will choose as our types, the matter becomes comprehensible. There is little doubt that all igneous magmas are originally in a vitreous condition, and that the passage from that state to a crystalline one must be accompanied by the evolution of an enormous amount of heat, just as occurs in the passage from the solid state of ice to the liquid water. Were the magma composed of a single chemical compound, we should expect that it would remain at a fixed temperature from the commencement of crystallisation to the complete solidification as the result of that process. This would not be the case in the lava in a volcanic chimney in which we should expect that the temperature would fall by steps, remaining fixed as long as any definite mineral species was crystallising, and would then drop to the crystallising temperature of the next species, again remaining for a certain time fixed. What these temperatures should be we do not know until the crystallising temperature of each rock-forming species is known. It must be remarked that the simple fusion point of any mineral is no indication of the temperature of the crystallising of a given mineral from a magma; for, in the former case we have to deal with a simple physical process, whereas in the latter it is often a chemical one. This is illustrated well in the case of orthoclase and augite, which both crystallise before leucite, which can only be explained by a chemical reaction taking place in the magma.

This process I take to be dependent upon a magma open to the atmosphere, by which the alkaline chlorides break up, the HCl being liberated and the free alkalies combining with the silica and alumina of the basic iron glass. Part of the iron separates as magnetite and part combines with the HCl and escapes in the vapour as chloride, always accompanied by some of the alkaline chlorides.

In fact, it seems an almost impossible task, the determining theoretically or even practically the temperature of solidification of a lava.

However, a clear comprehension of what has been said demonstrates how the supply of heat is kept up for a long time in the volcanic chimney, and the varying activity resulting therefrom. We have good reason to suppose that in our type of volcanoes there comes to the surface a uniform quantity of magma in a given time, although the extrusion may be more or less rhythmical, due to tidal and other agencies. Let us suppose that the magma has been so long simmering in the chimney that by volatilisation of steam, etc., it begins to become pasty. In that condition the escape of vapour from the lower part of the magma in the chimney cannot go on, and consequently the fall of temperature is arrested although crystallisation may go on for some time, so that the temperature of the lava rises. Meanwhile more water is being dissolved or taken up by the magma, and, in consequence of this and the rise of temperature, the tension of the magma increases until it overcomes the resistance of the pasty magma choking the upper part of the chimney. Then occurs a more or less strong paroxysmal eruption, in which, from the excess of water and the higher temperature there will result a tendency to the issue of the magma in a fragmentary condition, and this will approach more or less the scoriaceous or even pumiceous character. This is what is constantly occurring at Stromboli and even at Vesuvius, but in the latter it is much modified by the lateral oozing of lava, the effect of which I propose to treat of elsewhere.

In fine, we must conclude that the calorific capacity of the original vitreous magma must be very great, although its temperature may not be very high, and that its heat energy under favourable conditions may keep up the temperature for a long time. This would be the case in a volcanic chimney when solidification was taking place by crystallisation instead of cooling as a glass—a similar condition, in fact, to what we observe in the solidification of melted sulphur.

The same author then read a *Note on a Mass containing Metallic Iron found on Vesuvius.*

He also contributed a *Note on the Occurrence of Leucite at Etna.*

Professor E. W. Claypole, B.A., D.Sc. (Lond.), F.G.S., of Bochtel College, Akron, Ohio, U.S.A., contributed a *Note on Some Recent Investigations into the Condition of the Interior of the Earth.* The difficulty of this great problem in geology was referred to as a reason for the slow progress made towards its complete solution, and indirect nature of the evidence was also quoted as a source of uncertainty. The chief element upon which reliance can be placed is the now seldom disputed datum that the earth must in all these inquiries be regarded as a heated body in cold space subject to laws of radiation as yet imperfectly understood. Reference was then made to the recent investigations of Mr. C. Darwin, Mr. T. M. Read, the Rev. A. Fisher, and Professor G. Darwin, claiming to prove that the following deductions from this datum have been established.

(*a*) That below 400 miles the cooling and consequently the contraction are imperceptible.

(*b*) That the cooling and consequently the contraction reach their maximum at the depth of 72 miles.

(*c*) That at the depth of five miles the contraction from cooling exactly equals the diminution of space due to the descent of the shell ensuing from the total vertical contraction of all the layers.

This layer, at the depth of five miles, has therefore been termed "the layer of no strain," being liable neither to extension nor compression, because the space is exactly sufficient for its diminished bulk. The layer of no strain is placed by one of the authors above named at the depth of five miles, and in a neutral zone between the bent and crushed strata above, and the compressed and horizontally extended strata below it. It is consequently impossible that any disturbance can occur in the layer of no strain.

Yet in some parts of the earth, and notoriously in the Appalachian region of North America, strata have been forced up from a depth greatly exceeding this limit. Beds are now exposed, which at the time of their folding, lay fully eight miles below the surface, and must therefore have been far below this neutral zone, which was then (at the end of the palæozoic age) less than five miles deep. Similar facts might be adduced from other parts of the world, and it is therefore difficult to avoid the conclusion that the layer in question has been placed too near the surface, though of the actual existence of such a zone after a careful study of these investigations scarcely a doubt can be entertained. The Professor concluded by pointing out that this theory would limit the depth and origin of earthquakes to a five-mile depth.

The President said the subject was one of exceeding difficulty, and exceeding interest, and it was a subject, moreover, upon which hardly any two observers were likely to come to exactly the same conclusion. To the point put before them by Professor Claypole they must really devote some discussion. Geologists were plain folk; they required evidence put clearly and plainly to the front, and he thought there was really no evidence of any such divisions.

The Rev. E. Hill, M.A., F.G.S., who pointed out that mathematicians (the authors of the theory put forward by Professor Claypole) obtained their deductions from hypotheses, declined to discuss that question, but confined himself to the question of volcanic agency. There were, he said, several theories of volcanic action. There was the theory of the crushing process; there was that of the gradual percolation of water to the heated depths; there was that of the sudden intrusion of water into the heated core; and there was the later one, which had much to say for itself, of heated gas gradually forcing its way out from the central nucleus. Some facts seemed to point in favour of one hypothesis and some in favour of another. For instance, the description which Miss Bird gave of a volcano in one of the Sandwich Islands, as that of a constant boiling going on, seemed to be best explained by the theory of heated gas; or, again, the fearful eruption which, in New Zealand, destroyed those wonders of the world, the Pink and White Terraces, seemed much more clearly to be attributed to the sudden intrusion of the waters of the lake into the heated central mass. Other observations pointed to other causes, and he was inclined to think they often made the mistake when they saw one phenomenon of immediately considering it must be due to one cause, whereas he strongly suspected that in these matters several causes were at work.

Dr. Irving, after dealing with the presence of flame in volcanic eruptions, pointed out that the architecture of the earth's crust was such as to throw serious difficulties in the way of Professor Claypole's theory of a zone of "no strain," especially in view of the fact that in earlier periods such a zone must have been much nearer the surface.

Mr. Stanley criticised the mathematical calculation by which the theory had been arrived at.

Mr. Beaumont, Mr. W. White, and Mr. Fergusson followed.

The Rev. F. Howlett, F.R.A.S., said he was astonished to hear the statement made by the mathematicians that at the depth of 400 miles the central mass was incapable of further cooling. If that were so what became of the theories and functions of the laws of convection currents of temperature? He was utterly incapable of comprehending how such a state of things could possibly be arrived at.

The President followed with a vigorous onslaught on the "no strain zone" theory. They had already heard some objections which, to his mind, were insuperable objections—that by the last speaker particularly. It was asserted that the temperature of the earth beyond the 400 miles limit would remain the same for ever and ever! That was a hypothesis which they could not for one moment entertain, unless they had most ample and conclusive proof. Now for this five-mile line—the line of "no strain." Now if there ever had been, at a depth of between one and five miles, such a layer as that then it seemed to him that in those thicknesses of rock which they were able to examine and test by the most minute methods of observation—he meant the stratified rocks—they would find evidences of certain strata in which there were no traces whatever of strain. As a geologist, he was bound to believe there were no such strata. His experience of the ancient history of the earth practically amounted to this, that the very deepest, the very oldest of the stratified rocks were those which had suffered the greatest amount of crumbling, the greatest amount of physical change, the greatest amount of folding. In other words, those which were sunk deepest were those which were compressed most. He found no trace whatever of this layer under consideration. Now for another point. It seemed to him that the condition of the interior of the earth was not to be made out by any mathematical assumptions, but it seemed to him they were really in the position of forming some definite idea from the modern development of stellar chemistry, of the application of spectrum-analysis to make out the physical constitution of the sun and stars, the planets, the meteorites, and the moon. And when from this he knew that space was full of bodies in various conditions of heat; when he knew that the planets varied from one another in their degrees of heat; when he knew that the moon was absolutely cold and lifeless, but that its physical constitution showed that in ancient times it was intensely hot; when he turned to meteorites, and saw before him heavy metallic and stony masses, which, at the time they were revolving in space and before they became entangled in the earth's atmosphere, were cold, and yet, which they knew from their very physical constitution, were originally intensely hot; when he knew all this he was bound to believe that there was a general law by which there was a steady loss of heat, and by which the intensely heated bodies gradually grew colder and colder, until at last even such a mass as the sun himself would become as cold as the meteorites. In the face of all such evidence it was wholly impossible for them to believe that the cooling of the earth was to be stopped at the 400 miles limit. The President devoted some further remarks to this subject, couched in the same tenour, and concluded by pointing out how appropriate it was they should be discussing the question of volcanic phenomena in that room, for it was at the last Bath meeting, in 1864, that the President of that section was his old master—Professor Phillips—and Professor Phillips was the historian of Vesuvius.

Dr. JOHNSTON-LAVIS said that volcanologists could trouble themselves but little about the interior of the earth, their time being taken up with studying the phenomena themselves, the origin of the material thrown up, and its cooling at the surface. He nevertheless rejected all Professor Claypole's theories, both because they assumed the crust of the earth to be one uniform mass and of one uniform thickness. He protested, also, against the theory that earthquakes and volcanic activity were confined to a depth of five miles, which, on the showing of the "no strain" zone, they would be. His experience led him to believe that the distribution of earthquakes on the surface was in proportion to their depth. The great Charleston earthquake, he believed, to have a depth of at least twelve miles, while other earthquakes of limited area he believed to be similarly limited in depth. To suppose that vast earthquakes, spreading over hundreds and thousands of miles, were limited to five miles depth was impossible; and he did not know how mathematicians could make such an assertion. With regard to the origin of volcanic action, he attributed the large amount of literature on the subject to imperfect information, and he entered a strong protest against the perfunctory system that some have of pretending to investigate these phenomena, saying that, before a proper opinion could be formed, it was necessary to be on the watch night and day for years together. Volcanic activity, he believed, did bear a relation to the barometer and the thermometer. It had been statistically proved that there was a definite relation between volcanoes and the tide and the position of the moon. For five years he had carried out a daily record at Vesuvius, and he found distinct evidence that the activity of the volcano was in most remarkable relationship to barometric pressure. As for the theory of the gradual percolation of water to the heated mass, he regarded it, to say the least, as a very crude theory.

Professor CLAYPOLE agreed with most of the objections which had been taken. No evolutionist could for a moment doubt the truth of the law of cooling which the President had referred to; but nevertheless, the President's objection was like a pyramid standing on its apex—it had no foundation. The mathematicians never intended it to be understood that cooling entirely ceased at 400 miles limit—they would be the last to accept such a corollary. What the mathematicians meant was this—that in discussing one of these intensely difficult mathematical problems their formularies became so long and complicated that they were bound to leave out all elements not absolutely necessary; and by drawing the line at 400 miles they meant—not that cooling would entirely cease there, but—that beyond that line the radiation into space was so small as to be utterly unappreciable and valueless in regard to their calculations. In regard to the convection currents, he would reply that he must be a hardy geologist in the present day who would maintain that the earth is liquid enough for the convection currents to occur at a depth of 400 miles.

A paper was read *On the Causes of Volcanic Action*, for Mr. J. LOGAN LOBLEY, F.G.S. After citing recent opinion as to the absence of an adequate explanation of the causes of volcanic action, the author showed that the accumulation of knowledge of the controlling facts of volcanic phenomena and the amount of attention which had been given to the question placed the subject on firmer grounds, and made the finding of a satisfactory solution of the problem now more probable.

The difficulty of the question lay in the great number of facts and the apparent conflict of many of them.

It was, in the first place, necessary that the leading and controlling facts should be recognised and kept in view. With this object a compendium or concise statement of forty-two such facts was given, followed by a brief review of the various theories that had been advanced, from Lemery's in 1700, to Prestwich's in 1886, with in each case numerical references to the facts in the compendium which were, in the author's opinion, at variance with the respective hypotheses.

The author's own conclusions were then submitted, which are, briefly, as follows:—

A. That the primary cause of the formation of lava is the internal heat of the globe inducing chemical action in subterranean regions where the materials and conditions are both favourable.

That since the fusion-point of temperature of solids is raised by extreme pressure, conditions for chemical action may be changed from unfavourable to favourable by the removal or relief of vertical pressure by lateral or tangential pressure.

That certain substances are fusible at low or moderate temperatures, and that thus at very moderate depths chemical action may be locally commenced that will extend until sufficient heat is produced to effect rock-fusion.

B. That the cause of the ejection of lava from its source, and its rise in the volcanic tube is the increase of bulk consequent upon the change from the solid to the fluid state, aided by the formation of potentially gaseous compounds by chemical reactions among the original materials of the magma.

That the ascent of the lava in the volcanic tube may be effected by the weight of the atmosphere and by lunar attractive influence, and that therefore a volcanic vent is a thermometer, and, secondarily, a barometer and helkusometer* combined.

C. That the explosive effects of volcanic eruptions are altogether secondary, and are due to the access of sea and land water to fissures, by percolation through cool rocks, up which lava is ascending.

That this water, when converted into steam, opens, by its expansive power, rents that admit large flows of sea-water to the lava, occasioning the formation of vents and the greater explosive phenomena of eruptions.

The formation of the actual surface volcano and the determination of its position is therefore due to the sea, near which volcanoes are almost always situated.

Emissions of lava without explosive effects are from volcanic tubes to which large flows of water have not obtained admittance, and, on the other hand, purely explosive eruptions, without lava flows, are caused by water reaching lava which fails to rise to the surface of the earth.

The various forms of volcanoes the author considered could be explained by these views, which opposed—

1. An infra-crust common central source of lava.
2. The passage of lava through thirty miles of rocks, and consequently through any greater thickness.
3. The ejection of lava from its source by vertical pressure.
4. The ejection of lava from its source by super-heated steam or "potential steam" force.
5. The passage of water through highly-heated rocks, either by fissures or by capillary transmission.
6. The accumulation or the presence of water at volcanic foci.
7. A primogeneal "water substance."
8. The importance of land surface water.

The author has given much thought during many years to volcanology, and had made personal observations of volcanic activity; and whether his views were approved or not he would be glad if they elicited facts and opinions that would further a solution of the problem. He thought a discussion on the subject would not be inappropriate at the city of Bath, famous as it was for thermal waters deriving

* From ἕλκυσις—εως = attraction.

their heat from what might be termed, according to his views, a volcanic focus, but in this case one from which only benefit to mankind was received.

The Eighth Report of the Committee, consisting of Mr. R. Etheridge, Mr. Thomas Gray, and Prof. John Milne, Sec., *appointed for the Purpose of Investigating the Earthquake and Volcanic Phenomena of Japan*, was then read.

Mr. O. H. Howarth communicated a paper on *The Recent Volcanic Structure of the Azorean Archipelago.* The object of the author's notes upon the relation of the Azorean group to the other islands of the West Atlantic was to indicate a line of inquiry by which some approximation might be made to the intervals separating the great eruptive changes; and to determine any modifications in the type of flora during that important succession of volcanic products, which has been evolved since the Upper Miocene period assigned to the islands generally. A field for such inquiry seems to be offered by the present phase of action in the Furnas district, in the eastern centre of St. Michael's, where existing activity is associated with some of the oldest formations in the series. The author has traced in that valley a series of beds of vegetable origin dating back from the most recent changes, immediately connected with the present boiling-spring area, to a period antecedent to the formation of the Furnas Valley itself. The intermediate intervals of repose are now represented by peaty beds and subaqueous vegetable deposits, interstratified with the successive lava streams, tuffs, and pumice beds of various dates, within and prior to the historical period. From the more recent of these, buried trunks and branches have been obtained which represent the intervals of recent eruptions; while in one of the older tuffs, underlying nearly the whole series at that portion of the islands, a tree (probably an *Erica*) has been found, presumably *in situ*, and offering possibilities of a subjacent soil for examination, which would be contemporaneous with the earliest vegetation of the island.

Professor G. A. Lebour presented the *Report of the Committee appointed for the purpose of considering the Advisability and Possibility of Establishing in other parts of the Country observations upon the prevalence of Earth Tremors, similar to those now being made in Durham.* The report was brief and preliminary only. The Committee, it seemed, has hitherto been engaged in considering the question of the best instruments adapted for the work, and their investigations being still incomplete, they did not as yet make any special recommendation. While some carefully finished seismoscopes would be needed, it would be only in comparatively small numbers, while on the other hand a larger number of instruments would be required of less delicate character. Next year the Committee would be in a position to give a more definite report, when they would ask for a grant, the rough outline of the proposal being to have a number of small observing stations where time records of tremors would be registered, and a few very carefully selected stations, where the intensity as well as the time would be recorded.

Geological Department.

Mr. W. Whitaker, F.R.S., presiding. The following papers were read :—

The Watcombe Terra-Cotta Clay. By Mr. W. A. E. Ussher, F.G.S., of the Geological Survey of England.

Beds exposed in the Southampton New Dock Excavation. By Mr. T. W. Shore, F.G.S., F.C.S.

Fossil Arctic Plants from the Lacustrine Deposit at Hoxne, in Suffolk. By Messrs. Clement Reid, F.G.S., and H. N. Ridley, M.A., F.L.S.

Report of the Committee, consisting of Mr. J. W. Davis, Mr. W. Cash, Dr. H. Hicks, Mr. G. W. Lamplugh, Mr. Clement Reid, Dr. H. Woodward, *and* Mr. T. Boynton, *appointed for the purpose of investigating an Ancient Sea-Beach near Bridlington Quay.* Drawn up by G. W. Lamplugh, Secretary.

Professor H. G. Seeley, F.R.S., contributed a paper on *The Origin of Oolitic Texture in Limestone Rocks.* The author stated his belief that Oolitic textures have originated in many ways. It is found occasionally in Silurian, Devonian, and Carboniferous rocks; but it is most characteristic of the Inferior and Great Oolites, Coralline Oolite, and Portland Oolite. The structure is not limited to limestone, being found in carbonate of iron and oxide of iron. A similar structure has long been known in the Dolomitic rocks of Durham, but some of the concretions are of large size, and this condition is seen in the Sprudelstein at Carlsbad. Experiment has shown that carbonate of soda may be the basis of concretions of carbonate of lime if they are suspended under suitable conditions in solution of chloride of lime. Dr. Carpenter regarded Oolites as Foraminiferal limestones in which the foraminifera are invested with calcite. Dr. Sorley regarded the grains as pellets formed by current drifting, and the author attributed the small size of the grains to the small force of the currents. The author considered that the microscopic structure of nullipores was practically identical with Oolitic grains, so as to suggest that in some cases Oolites may be organic rocks.

Professor Gilbert described the Oolite now forming in the Great Salt Lake, and Mr. Wheeler, U.S.A., the Chairman, Mr. Woodward, Mr. Wethered, and Mr. Wedborne spoke on the subject.

Tuesday, September 11th.

The Rev. H. H. Binwood presiding.

The first paper read was on Professor F. Bassani's *Researches on the Fossil Fish of Chiavon, Vicentino.*

These fossiliferous marls were first discovered by Baron Zigno in 1852, who referred them to the Lower Miocene, since which time Heckel, Herr Suess, Sauvage, and others have studied their fauna and flora. The abundant materials investigated were derived from many public and private museums, and represented plants and animals, amongst which were a few crustaceans badly preserved, very few insects, many beautiful fish, two bones of birds, and some amphibia. An examination of the list shows that the Chiavon fauna include no Ganoids, and is constituted of Chondropterygeans and Teleosteans. The whole list is comprehended in fifty-eight species, distributed in thirty-two genera and fifteen families. Comparing the fish fauna of Chiavon with twenty-one other analogous deposits of Europe, the author has come to the conclusion that they are in age Aquitanian, or belong, like the strata of Sotzka, to the base of the Lower Miocene.

The report of the Committee, consisting of Mr. R. Etheridge, Dr. H. Woodward, and Professor T. Rupert Jones (Secretary), on the *Fossil Phyllopoda of the Palæozoic Rocks*, was read, as was also the report on the *Flora of the Carboniferous Rocks of Lancashire and West Yorkshire*, by Professor Williamson.

Professor H. G. Seeley, F.R.S., gave an elaborate description of an *Ichthyosaurus from Mombasa*, with observations on the vertebral characters of the genus.

Mr. A. Smith Woodward, F.G.S., F.Z.S., read an interesting paper, in which he drew *a Comparison of the Cretaceous Fish-fauna of Mount Lebanon with that of the English Chalk.* He also read a paper on *Bucklandium diluvii König, a Siluroid Fish from the London Clay of Sheppey.*

Professor W. Boyd Dawkins, in the course of a few incidental remarks, alluded to the curious inversion of parts noticeable in some fishes, and instanced the common sole, which by dint of continual squinting caused the eye to travel right round the orifice to the upper surface in a curiously inverse fashion.

Mr. W. Terrill (Swansea) and Dr. Johnston-Lavis asked for and obtained further information.

Dr. C. Ricketts, F.G.S., read a paper on *A Probable Cause of Contortions of Strata.* The amount of compression to which the crust of the earth would be subjected as the effect of subsidence, by the presence of faults and other causes, as well as by the secular cooling of its mass (Rev. O. Fisher, *Phil. Mag.*, Jan., 1888), is too inconsiderable to develop the great contortions and foldings certain strata have undergone.

When accompanied by cleavage, the distortion of contained fossils and the displacement of included rock fragments (the flat sides lying parallel to the cleavage planes) indicate that the change occurred whilst the clay deposits were in an unconsolidated or plastic condition.

It is suggested that these flexures may be dependent on irregular pressure, caused by the local distribution of larger and heavier particles on accumulations of unconsolidated muddy deposits, in a similar manner to what may be demonstrated by spreading layers of clay of various colours, dried and reduced to powder, in a trough; when, on the admission of water, the clay has become plastic, sand is heaped on some special part and extra weight applied, which in the experiment is necessary. The heavier substance subsides into the plastic mass, and at the same time the clay beds are squeezed outwards, causing the layers underneath to be formed into films, which are still continuous with those on the sides, though these are rendered considerably thicker than in their original state, and are curved into folds, even to reversal of the beds, representing on a small scale what are frequently met with in stratified rocks. The experiment so coincides with natural phenomena that it is reasonable to expect that it will prove to be a true and frequent cause of the cortortions of strata.

The paper was accompanied by models, the result of experiments, and Mr. A. S. Reid and Mr. W. W. Watts spoke on the subject. The latter said the experiments made by Dr. Ricketts required to be modified before they actually represented the facts as they occurred. He pointed out that the sides of the vessels in which the experiments were made involved conditions of pressure which did not occur in nature. The scale of the models, too, was untrue, as to represent the actual conditions the model of the Ganges Delta would have to be elongated to 250 feet. He agreed that Dr. Ricketts was discussing an undoubtedly real cause of contortion, but limited its application, and said that the contortion of a schist, Mr. Reid had produced, was on far too small a scale to have been effected on the theory propounded.

A paper, written by Mr. J. JOLY, M.A., B.E., was read, on *The Temperature at which Beryl is Decolourised.*

Experiments on some translucent green and yellow beryls from Glencullen, Co. Dublin, show that these beryls are almost entirely deprived of colour when exposed for one hour to a temperature of 357° C., *i.e.*, the temperature of boiling mercury at atmospheric pressure. The loss of colour takes place whether the beryls are out of contact with the air or not. It was found further that exposure to a temperature of 230° C., for the space of thirty hours caused a marked loss of colour. In all cases the crystals retain their translucency. They have shown no signs of regaining colour during a lapse of three years since the date of the experiments. The author suggests that this observation may bear on the history of the containing granite subsequent to the formation of beryl, if the colour of the latter be regarded as indicating a major limit to the changes of temperature experienced by the rocks.

A second paper prepared by Mr. JOLY was read, on the *Occurrence of Iolite in the Granite of the County Dublin.*

Mr. W. W. WATTS gave an address on *Igneous Succession in Shropshire,* illustrating his remarks by diagrams. The author described the succession of igneous rocks in the Shelve and Corndon district of Shropshire. The earliest rocks had a high percentage of silica, and this diminished on each successive phase of volcanic activity, of which four stages were noted, so that the lightest rocks were erupted first, and densest rocks later. The last part of the paper was taken up with a discussion on the mode of occurrence of these rocks, which had been intruded into spaces formed during the folding and faulting of the strata.

A brief report was presented from the Committee appointed to investigate *the Circulation of Underground Waters in the Permeable Formation of England and Wales, and the Quantity and Character of Water supplied to various Towns and Districts from these Formations.* The drought to which the Committee drew attention, in its last report, continued up to June of the present year, and had a very marked influence in diminishing the volume of water yielded by a large number of springs, and a very considerable diminution in the supply afforded by the remainder over the greater portion of the central area of England, an area in which underground stores give the larger proportion of the daily water supply of the population. Much useful information had been obtained as to the amount of diminution experienced, but it had been thought desirable to combine it with information now being collected, showing the effect of the recent heavy rains in recharging the underground stores. Such statistics as to the most exceptional season of the present century would have a permanent value in future calculations as to the actual yield likely to be obtained from a given area after successive years of minimum rainfall, and this information was deferred until next year. It was hoped local observers would give special attention to diminution and increase in the yield of the springs.

A list of works was presented, referring to *British Mineral and Thermal Waters*, the CHAIRMAN remarking it was very appropriate such a list should be presented in Bath.

The Rev. Dr. IRVING dealt with the *Origin of Graphite in the Archæan Rocks*, reviewing the alleged evidence of life on the earth in archæan times. He asked, is archæan graphite of organic origin? So convincing has the presence of graphite appeared to some minds as evidence of the pre-existence of vegetation that in the report of the Smithsonian Institution (quoted by Dr. Sterry Hunt in his "Geological Essays"), the presence of graphite, even in aërolites, is said to "tell us in unmistakable language that the bodies came from a region where vegetable life has performed a part not unlike that which it still plays on our globe." It is well known that carbon does occur on meteorites; graphite—identical in properties with iron-graphite—was identified by Berthelot in the meteoric mass which fell at Crambourne, near Melbourne, in 1861; and during last year it was stated in *Nature* that carbon has been found between the caminal of the great mass of meteoric iron which fell near Cabin Creek, Johnson's County, Arkansas, in March, 1886. Mr. Lockyer's recent experiments on meteorites with the electric spark have given spectroscopic evidence of the presence of carbon in such bodies in some cases. Dr. Sterry Hunt, in his "Chemical and Geological Essays," remarks, "Graphite, which itself encloses apotite, is found included alike in quartz, pyroxene, and in calcite, in such a manner as to lead us to conclude that the crystallisation was contemporaneous with that of all these minerals." The alleged necessary phytogenic origin of graphite had, it appeared, no direct evidence to support it beyond the known fact that it occurred occasionally in later formations, as the result of extreme carbonisation of organic matter of vegetable origin. If, therefore, it could be shown that graphite could be produced in any other way in the archæan rocks it was evident that we must cease to urge its presence in these rocks, as evidence of contemporaneous organic life. Let them consider a few demonstrable facts as bearing upon the question. They knew that graphite occurred in segregated minute masses in "grey" or pig iron, and that it exuded from that metal in the process of cooling, to crystallise in the form of hexagonal plates. It was well known and easily demonstrated in the chemical laboratory that carbon could be obtained in the purest form by the reducing action of metals, of the alkalies, and even of magnesium, upon ordinary carbonic acid gas at high temperatures, or by chlorination of hydro-carbons at red heat. They knew that hydro-carbons could be formed, and were formed frequently in the laboratory by direct combination of carbon with elementary hydrogen, acetylene being formed by direct synthesis of hydrogen with carbon vapour at the temperature of the electric spark discharges. Marsh gas, too, had been produced by the reaction of carbon bisulphide upon hydrogen-sulphide, in contact with heated metals such as copper. More complicated hydro-carbons were produced when certain metals, such as iron united with carbon, and the metallo-carbides thus formed were acted upon by mineral acids. If now, it were to be admitted that the earth had developed out of a portion of the original nebulous mass from which the solar system is derived, it must have passed through such a condition of things that hydro-carbons must have been formed synthetically by such processes as had been mentioned, perhaps by others which laboratory research had not yet discovered. Given, then, the existence of hydro-carbons in the dense archæan gaseous envelope which enshrouded the glowing lithosphere of archæan rocks, it could easily be shown that carbon would be deposited from them. During the last two months the author had produced copious deposits of soft, amorphous carbon by the contact-action of heated fragments of previously calcined pumice upon currents of ordinary coal-gas. He had also observed that the carbon deposited at an incipient red heat had the steel-grey lustre of graphite, and that at higher temperatures, up to the incipient fusion of the hardest Bohemian glass, the carbon deposited had a more sooty character. From such evidence they were justified in inferring the deposit of graphite in the earliest crystalline rocks, by the dissociation of hydro-carbons through the contact-action of such rocks at high temperatures, as probable. As to animal life, he could only say that any one who, with a fair command of the German language and a moderate acquaintance with protozoan forms, could form a judgment of the merits of the eozoön controversy from an acquaintance with Möbin's splendid monograph, *Der Ban des Eozoon Canadense*, must admit that the evidence of the organic origin of that structure was very slender indeed. And in the face of the overwhelming physical evidence against the possibility of life on this globe, as we know it, having appeared in archæan times, the evidence of such mere mineral infillings representing organic forms must be made infinitely stronger than it has yet been made in order to establish a case.

A brief discussion ensued in general terms, and after the Rev. G. F. WHEDBORNE had read papers on *Some Fossils of the Limestones of South Devon* and on *Some Devonian Crustaceans*, the section formally brought its sitting to a close.

GEOLOGICAL DEPARTMENT.

W. WHITAKER, Esq., presiding.

Dr. T. STERRY HUNT, F.R.S., read a paper on *Mineralogical Evolution*, in the course of which he said, Mr. E. A. Ridsdale, who during the present year (1888) has done good service by publishing a suggestive essay, called "Notes on Inorganic Evolution," spoke of the production and conservation of more stable species as a gradual "selection of inert forms," and further, as "a survival of the most inert." But as inertness consisted in stability, and in fitness to resist alike the chemical and mechanical agencies which destroyed other species, it was evident that his phraseology is but another statement of the formula of "the survival of the fittest."

The great principle of the change of the mineral matters which existed in former conditions of our planet into other forms more stable, under the altered conditions of later ages, is but an extension to the mineral kingdom of the laws already recognised in astronomical and biological development. As was written in 1884, "That a great law presided over the development of the crystalline rocks was from the first the author's conviction, but until the confusion which a belief in the miracles of metamorphism, metasomatism, and vulcanism had introduced into geology had been dispelled the discovery of such a law was impossible." To this may be added that "the great successive groups of stratiform crystalline rocks mark necessary stages in the mineralogical evolution of the planet," and that the principles which have elsewhere been laid down will help us "to recognise the existence and the necessity of an orderly lithological development in time."

The CHAIRMAN and Professor J. F. BLAKE asked questions on the subject, and the points they referred to were further elucidated by Dr. HUNT.

The report was prepared at considerable length, but Professor Blake only read the conclusions he had arrived at, the bulk of the paper being taken up with detailed description of the rocks referred to, 252 in all. The series described, he said, were so various in their composition and structure that the results of their study could not be fully stated in a single proposition, but there were many conclusions of which they either afforded demonstration or rendered the probability considerably stronger. These were thirty-two in number, the chief of which were referred to and explained on the black-board.

Professor J. F. BLAKE presented a report upon the *Microscopic Structure of the Older Rocks of Anglesey.*

BIOLOGICAL SECTION.

(*Continued from p.* 265.)

MONDAY, SEPTEMBER 10TH.

Mr. W. T. THISELTON-DYER, F.R.S., presiding.

The Report of the Committee on the Marine Biological Station at Granton, in Scotland, was read by Mr. W. E. HOYLE.

The PRESIDENT, in commenting upon the report, said the sea afforded problems of extreme interest, and he trusted that the Association, having supported the work that was done at the various stations for some years past, would continue to give that aid, though it might not possibly be done in precisely the same manner as had hitherto been adopted. He could not believe that there would ever be wanting workers to take advantage of the appliances and conveniences which those stations afforded, and at subsequent meetings of the Association a very important feature of the proceedings would be accounts of investigations which had been made at those places.

Mr. HARMER, M.A., B.Sc., presented the report of the Committee on *the Development of the Oviduct in Teleostei.*

Mr. F. W. OLIVER, B.A., D.Sc, etc., gave an address on *Certain Adaptations for the Nutrition of Embryos.* He pointed out that in the new Chinese aquatic plant *Tapeiha* very remarkable accessory feeding organs were revealed at either end of the embryo-sac, which indubitably absorb food material which is handed on ultimately to the developing embryo. The organs which functioned in this way were respectively the *Synergidæ* and the terminal cell of the series of cap cells. This extraordinary state of things was co-ordinated with the atrophy in this plant of the raphe—the normal channel of food-material to the embryo. An absolute parallel occurred in the *Loasaceæ*, where the vascular bundle of the raphe was also wanting; and here a series of curious suckers were also found, these being special outgrowths of the embryo-sac. The author, in conclusion, gave a detailed review of feeders identical in function, though widely differing morphologically, in such plants as *Lathræa*, *Tropaeolum*, *Thesium*, and many orchids.

A brief discussion followed the delivery of the address, in which the PRESIDENT, Professor MARSHALL WARD, Mr. WALTER GARDINER, and Professor BOWER took part, the opinion generally expressed being that the investigations of Mr. Oliver were of great interest and importance.

Mr. C. A. BARBER read papers on *The Development of the Bulb of Laminaria bulbosa* and *Pachytheca, a Silurian Alga of Doubtful Affinities.*

The former paper was discussed by Dr. FRANCIS DARWIN, Mr. W. GARDINER, Professor BOWER, and Mr. J. R. VAIZEY.

Other papers were by Professor HARTOG, *A Preliminary Note on the Functions and Homologies of the Contractile Vacuole in Plants and Animals;* and by Mr. W. GARDINER, on *The Contrivances for the Seed Protection and Distribution in Blumenbachia Hyeronomi* (*Urban*).

Professor MARSHALL WARD, F.R.S. (for Mr. PERCY E. NEWBERRY) read an extremely interesting paper on *The Plant Remains Discovered by Mr. W. M. Flinders Petrie in the Cemetery of Hawara, Lower Egypt.* The author pointed out the importance of this discovery to botanical science. He briefly reviewed the species of plants determined by him among the ancient remains, and called attention to the fact that only a very small number were undoubtedly indigenous to Egypt. He had examined all the plant remains and found that they possessed the minute and, in some cases, apparently accidental peculiarities of their existing representatives. He did not wish to point out the bearing of these facts on any theoretical views entertained at the present day. He merely wished to place them before the members of the section as data which must be taken into account in constructing such theories, and as confirming the long-established axiom that by them, at least, as workers, species must be dealt with as fixed quantities. The author exhibited a series of the plant remains to illustrate his paper.

Dr. FRANCIS DARWIN and the PRESIDENT made some laudatory observations concerning the paper.

Mr. E. J. LOWE read an interesting paper, the joint production of Col. Jones and himself, on the subject of *Abnormal Ferns, Hybrids, and their Parents.* A number of specimens were produced and handed round among the members, some of them being ferns of great beauty.

ZOOLOGICAL DEPARTMENT.

Mr. P. S. SCLATER, M.A., Ph.D., etc., presiding.

Mr. S. BROWN read an interesting paper on *Locusts in Cyprus.* He gave a brief description of the habits of the common Cyprus locusts, and of the system which has been successfully employed for their destruction in Cyprus. These insects, he said, had from time immemorial been the scourge of the island, and as under the Turkish rule little was done to keep them down, their ravages formed probably the chief agency in reducing what was once a fertile and flourishing island to a condition of comparative desolation. Successful efforts were, however, made by the Turkish Government from 1862 to 1870 for the destruction of the locusts, and in the latter year the island was so far rid of them that for some time no injury was sustained by the crops. But the Government relaxed its exertions, and the locusts again bred and multiplied, until by the time of the British occupation of 1878 they had so increased as to cause anxiety for the future. Acting under local advice, the Government attempted to keep them down by collecting and destroying their eggs. This operation was continued for three years on a vast scale, involving a heavy outlay, but without success; for although this method was adopted on a scale almost without precedent, the locusts continued to increase with alarming rapidity, until, in 1882, they swarmed throughout the plains, and in spite of various attempts to destroy them, the damage sustained by crops was very great, and probably did not fall short of £80,000, or from 15 to 20 per cent. of the value of the crops on the infested area. In 1883 and 1884 operations against the locusts were limited exclusively to attacking them in the crawling stage by the apparatus known as the Cyprus system of screens. These were formed of canvas, and were stretched across the line of march, so that the onward progress of the locusts was arrested, and they were then diverted into pits, carefully trapped, from which there was no escape. By the operations of these for two years the power of the locusts was so effectually destroyed that no damage whatever has been sustained by the crops during the past five years; and although it was still necessary to watch the locusts and prevent their increase, this was now done at a comparatively small annual outlay, and their numbers had so steadily decreased year by year as to warrant the hope of their final extermination. In submitting the paper to the Association the author was influenced by the hope that some of its members might be able to throw light on problems which, although they had received from him considerable attention, he had been unable hitherto to solve in a definite and satisfactory manner.

The PRESIDENT having offered a few observations concerning the subject treated of in the paper—

The Rev. Canon TRISTRAM detailed his experiences in Cyprus and of the locust pest in that country. He expressed an opinion that it was almost hopeless to expect to exterminate the locusts of Cyprus.

Mr. E. B. POULTON, M.A., made several suggestions with the view to obtaining more complete observations in regard to the breeding of locusts.

Mr. W. E. HOYLE gave a description of *Dredging and Trawling Operations which he had been prosecuting in the Firth of Clyde,* which contained some six or seven deep water basins, separated by more or less shallow ridges. The object of investigation was to compare accurately the inhabitants of these various basins. The occurrence of numerous interesting forms of life was recorded several of which had hitherto been regarded as peculiar to Norwegian and Arctic regions.

Mr. W. E. HOYLE, in explaining *A New Deep-sea Tow Net,* said its object was to enable the sea geologist to determine with certainty the exact depth at which free swimming organisms wer obtained. The net was a conical bag two or more feet in diameter, and some six feet long, of a degree of fineness proportioned to the size of the animals it is intended to capture. The net is attached to a folding hoop, to which two rods are attached, so that on towing it by one of these it will open, while on towing it by the other it will shut. It is let down closed, and when it has reached the required depth a small weight, known as a messenger, is allowed to slide down the rope, and by touching a spring lever let go the first rod, so that the rope hangs by the second and opens. When the net has been working for a sufficient length of time another messenger reverses the process, and the net is brought up closed.

Mr. F. E. BEDDARD, M.A., F.Z.S. (Secretary to the section), characterised the invention of Mr. Hoyle as very important, an expression of opinion in which the President concurred.

Mr. J. J. LISTER, M A., described a number of points in *the Natural History of Coral Fungia*, illustrating his remarks by blackboard sketches.

TUESDAY, SEPTEMBER 11TH.

Mr. W. T. THISELTON-DYER presiding.

The PRESIDENT remarked that the section had met in conjunction with their colleagues from the Geological Section, to consider a question which at the present time was very much attracting the interest not merely of biologists, but also of geologists—the vexed question which had been raised with respect to the origin of *Coral Islands and Coral Reefs*. One of the earliest researches of the late Mr. Darwin was a memoir upon the origin of these islands, and in it he was disposed to attribute them in great measure to the subsidence of the land upon which they were ultimately formed. He would not anticipate the statement of the reader of the paper as to the points of difference between Mr. Darwin's views and those which were now held, but it was in consequence of the explorations of H.M.S. *Challenger* that a series of facts were brought before the scientific world which in some degree made it extremely probable that Mr. Darwin's views did not form the only explanation to which these curious phenomena were susceptible. A very distinguished individual had thought fit to bring before the scientific world the preposterous assertion that they were leagued together in a conspiracy of silence with the object of suppressing the progress of scientific truth. He (the President) could not pretend that that assertion had influenced him in discussing the question upon the present occasion. It so happened that they had the presence of two distinguished scientific men who had had opportunities of examining these questions for themselves. They would state their views, and those present would be able to judge for themselves in which direction they would be inclined to think the ultimate solution of the problem might be found. At any rate, he thought they might claim that their minds were absolutely open, and that they attributed no weight to the authority of tradition, however eminent. All they really wanted to know was the conclusion which commended itself to their minds with the greatest probability, and which was based upon the largest number of ascertained facts.

Mr. SYDNEY J. HICKSON, M.A, D.Sc., Deputy Linacre Professor at Oxford, then read his paper on *Theories of Coral Reefs and Atolls*, but before doing so he said he felt it to be the duty of the opener of such a discussion as that upon which they were about to enter first of all to explain the phenomena concerning which the discussion was to take place, and then to state as impartially as possible the different views held to explain the phenomena. The object of the discussion was, if possible, to arrive at the truth, and not to run any particular theory. Thus, he would endeavour to state as impartially as possible the different views which had been put forward to explain the presence of atolls and barrier reefs; and although he could not help indicating in his opening remarks the view which he was inclined to hold himself, he would endeavour to postpone his prejudice to that view to a subsequent part of the discussion. He hoped none of those who followed him would consider that his mind was so prejudiced that they would not be able to convince him that he was wrong in the view he took.

The PRESIDENT said all would agree in according to Mr. Hickson a hearty expression of thanks for his interesting paper. If he had any fault to find with it, he might say it had been of a too judicial and well-balanced character—that he had rather taken the sting out of anything like an animated controversy. They could not help admiring the fair way in which he had brought forward the arguments for and against in this controversy, and it would be a difficult matter to attack him.

Professor W. BOYD DAWKINS, M.A., F.R.S, Dr. J. EVANS, Mr. G. C. BOWNE, Professor SEELEY, Mr. S. F. HARMER, Dr. MILL, and Mr. POULTON continued the discussion.

There were also papers read by Professor HALLIBURTON, report of the Committee on *the Physiology of the Lymphatic System*; by Mr. F. E. BEDDARD, *Contributions to the Anatomy of the Tuberficidæ*; by Professor HALLIBURTON (for Dr. Collins), *The Effect of Various Substances upon the Rate of Secretion and Constitution of the Bile*; by the Rev. R. BARON, *On the Flora of Madagascar*; and Professor GILSON, *On the Odoriferous Apparatus of the Blaps mortisaga.*

Mr. E. J. LOWE, F.R.S., read a short paper on the *Effects of the Weather of* 1888 *on the Animal and Vegetable Kingdoms.* He first drew attention to the extraordinary mortality amongst birds, and the fearful increase in the number of slugs and insect pests during the present summer near Chepstow. At Shirenewton, at the present time, there was not a wren, redbreast, goldcrest, coal-tit, marsh-tit, long-tail-tit, nuthatch, creeper, night-jar, green wagtail, lesser spotted woodpecker, redcrest, redstart, blackcap, white-throat, or redpole, although usually they were all common. There were scarcely any examples of landrail, water-ousel, missel-thrush, thrush, dunnock, whinchat, garden-warbler, willow-warbler, greenfinch, house-sparrow, hawfinch, sisking linnet, or swallow, although these are also usually common in the district. Amongst birds of which there were an average number might be mentioned the crow, rook, jackdaw, magpie, jay, swift, sparrowhawk, skylark, moor hen, blackbird, and starling. Usually birds were so abundant here that without nets cherries, strawberries, raspberries, currants, and gooseberries were all devoured by them. This year there had been no necessity for nets, as the fruit had been untouched by birds, or rather there were no birds to eat it. The long, deep snow in February destroyed many birds, but this did not account for the absence of so many summer birds. Only four or five swallows could be seen at one time, and only a solitary landrail had been heard. During the past two or three weeks there had been an increase in the following species: blackbird, willow-warbler, sparrow, chaffinch, great-tit, blue-tit, spotted fly-catcher, swallow, and martin. It might be mentioned that in June a pair of sand-grouse were seen to settle close to the cricket-ground in Shirenewton Park, but they were not seen again. There was almost always an increase in the number of slugs and insect pests after a cold winter, and this year that increase has been enormous. All seedling plants, vegetables, leaves, and flowers had been destroyed wholesale, and great damage had been done to wheat, grass, and other agricultural crops, but what had been most noticeable was the destruction by caterpillars of all the leaves of the oak. Thousands of oaks had been without a leaf—bare, like winter—and now they were only just coming into leaf again; but unfortunately a second crop of caterpillars was noticed on Sunday last to be resuming their attack on the new leaves. The damage to the oaks had extended for miles around. There had been a great increase amongst destructive slugs of various kinds, and earwigs, woodlice, ants, butterflies, and beetles had been unusually abundant, but there had been an absence of wasps and very few moles. Snakes and adders had been very numerous. Early-sown peas were twenty-one weeks before they were fit for the table, and all fruit had been very late, many gooseberries being not yet ripe, and currants being still abundant. Pears were scarcely swelling, and of mushrooms there were none. Nuts were an enormous crop. The hay-crop had been the latest ever known, much remaining unharvested at the beginning of the month. Although toads and frogs had deposited vast quantities of eggs, as usual, in the sheet of water in Shirenewton Park not a single one had resulted, nor did the egg swell. The water-newt had also been absent. It was worthy of remark that many delicate plants were uninjured by the cold of last winter. The author explained that his reason for contributing the paper was in order that the facts might be recorded for future comparison.

Professor MARSHALL WARD having offered a few observations—

Mr. HENRY SOUTHALL proposed a vote of thanks to Mr. Lowe for having contributed such an interesting paper, and the resolution was carried amidst applause.

Mr. F. T. MOTT read extracts from the report of the Committee, consisting of Professor Valentine Ball, Mr. H. G. Fordham, Professor Haddon, Professor Hillhouse, Mr. John Hopkinson, Dr. Macfarlane, Professor Milnes Marshall, Mr. F. T. Mott (Secretary), Dr. Traquair, and Dr. H. Woodward, reappointed at Manchester for the purpose of preparing a further report upon *the Provincial Museums of the United Kingdom.* This we may print in full at a later date ..

Professor SCHOFER said he had often been questioned by outsiders as to the use of the British Association. A complete answer to the question was found in the admirable report which Mr. Mott had read, and he hoped the suggestions it contained would be adopted, and that some practical result had been achieved. He asked Mr. Mott whether anything had yet been done.

Mr. MOTT said that copies of the first report of the Committee had been forwarded to the curators of all provincial museums, and he intended to ask that copies of the present one should also be forwarded to them.

GEOGRAPHICAL SECTION.

(*Continued from p.* 266.)

MONDAY, SEPTEMBER 10TH.

Col. Sir C. W. WILSON, R.E., F.R.S., presiding.

The first paper read was one by Sir LAMBERT PLAYFAIR, entitled *Tunis since the French Protectorate*, of which the following is an abstract:—

A very short time ago the interior of the country was practically a *terra incognita;* now it is being rapidly opened out to European enterprise, and it promises soon to rival Algeria in what must always be the principal industry of North Africa, viticulture.

Commerce also has increased in a notable manner, but the beautiful and characteristic arts of the country appear to be in a state of decadence.

The second paper on the list, entitled *The Commercial Future of Central Africa*, was read by its author, Sir FRANCIS DE WINTON. In the course of his remarks he said it could hardly be doubted that the advance of civilisation in the district dealt with would only be a question of a few years.

Mr. FORD read a paper on *The Transvaal—the Safety of Stanley*, in which he advised any one who had any capital and an idea of emigrating to go to South Africa, the El Dorado of the future.

Amongst the speakers were Sir F. DE WINTON, who contended that with regard to Mr. H. M. Stanley, there was no cause for apprehension on his account. He was undoubtedly safe in the interior, and had probably met Emin Pasha some considerable time ago. With regard to the White Pasha, who was reported to have been seen in the region of the Congo, he said some people thought it might be General Gordon, but he thought however much they might hope it was he, there was but small chance of the lamented General turning up. Mr. Stanley had travelled these regions many times before, and he would undoubtedly turn up all right after a while. There was no more chance of his coming to grief than there was of his coming to grief in Bath, beyond the chances of mere accident.

Mr. RAVENSTEIN said he agreed with Sir Francis in all he had said, and he fully believed Mr. Stanley was safe and sound, and in due time he would turn up. The other gentlemen who spoke were Sir LYON PLAYFAIR, Sir R. FOWLER, and Mr. SILVER WHITE, of the Scotch Geographical Society, and Professor GEORGE.

Mr. H. H. JOHNSTONE gave a very graphic and realistic descriptive account of the *Cameroons.*

Dr. E. G. RAVENSTEIN next delivered an address on *Dr. Livingstone and Bangweolo, the First African Traveller's Last Journey*, in which he drew attention to the discrepancy between his map of the Bangweolo region and his account of the same in his Journal. Had Livingstone lived to finish his survey of the lake, it would have appeared very different.

TUESDAY, SEPTEMBER 11TH.

Sir C. W. WILSON, F.R.S., presiding.

The PRESIDENT read a paper by Col. J. H. BOLLAND, R.E., on *The Photographic and Photozincographic Processes Employed in the Ordnance Survey*, in which he explained at some length the various maps used in surveys of the country, mines, drainage, etc., and the way in which they were prepared. The photozincographic process was invented at the Ordnance Survey Office, Southampton.

General Sir H. E. L. THUILLIER said no brush ever touched the copies of the original maps produced and sent to head-quarters.

Dr. GUISBURG said, in Cairo there was a very old copy of the Bible which he tried to get when he was out there with Lord Wolseley, but he was unable to do so. He thought they might make a representation to the Government to borrow the Bible, when Sir Charles would take a copy of it, which would be very useful to students.

Other gentlemen entered into the discussion.

Mr. H. J. MACKINDER, M.A., delivered an address on *Geographical Terminology*, in which he pointed out that one of the great difficulties encountered in the learning of geography was the inaccuracy of the terms applied to physical features, and one of the worst of these was that used for the word "ocean." The present use of the word ocean, as in the case of the Southern Ocean, was perfectly fatal to beginners. By the way of teaching at present in vogue an impression was left in the mind that there were five plains in some way compatible. The mother of oceans was that great ring of water lying north of the Antarctic Circle.

Mr. SILVER WHITE discussed the paper.

A communication on *The River of Joseph, the Fayoum and Raian Basins*, by COPE WHITEHOUSE, M.A., was read. A few observations were made on the subject.

Captain CONYERS SURTEES read a descriptive paper on *A Mission to El Wedj*, giving in it a sketch of the manners and customs of the various Arab tribes inhabiting that region.

Mr. G. K. GILBERT, of the United States Survey Office, addressed the audience with regard to the manner of the *Preparation of Geological and Geographical Maps of the Survey and the Triangulation System of the Country.*

Dr. RAVENSTEIN said he was surprised to hear of the very small number of geographers the United States had contributed to exploring parties. Although Stanley had very strong claims across the Atlantic, he was undoubtedly an Englishman. He thought in a go-ahead country like America they would not be behind in such a great work.

Mr. GILBERT responded, remarking that their maps were not yet published, but he would show them some proofs to demonstrate that some work had been done.

Mr. W. BARRINGTON D'ALMEIDA read a paper on the *Panang* State of the Malayan Peninsula. The author said Panang was the district which lay between Tringana in the north, and Perak and Selangore in the west of the China Sea. This was practically *terra incognita*, and until 1875 no Englishman had been farther than the borders of the State. The question of railways was not Utopian. There were already several of them in full swing, and at Trass a Mr. Fraser was working a very large tin-mine. The heat of the State was very great, and the natives were much darker than they were on the other side of the peninsula. He never in all his travels met with such courtesy as he did in the Malay territory. All the spare time of the natives was devoted to top-spinning. The climate was good, and colonisation would be most beneficial.

Mr. MACKINDER read a paper on *The Characteristic Traits of the Aboriginal Inhabitants of Formo a*, by Mr. GEO. TAYLOR.

Signor CESARE TONDINI DE QUARENGHI read a paper on *The General Adoption of the Gregorian Calendar*, in relation with that of the universal hour, in which he pointed out that the Chinese had some time ago adopted the Gregorian Calendar, and there were no reasons why the Russians should not do the same. They were keeping outside the pale of civilisation by insisting upon being twelve days behind ourselves.

ECONOMIC SCIENCE AND STATISTICAL SECTION.

(*Continued from p.* 268.)

SATURDAY, SEPTEMBER 8TH.

MR. R. H. INGLIS PALGRAVE, F.R.S., F.S.S., occupied the chair.

The first paper read was on *The Revenue System of the United States*, by Dr. ALBERT SHAW, Ph.D.

Mr. R. H. INGLIS PALGRAVE, F.R.S., F.S.S., then read a paper on *The Distribution of the Licences proposed to be transferred in aid of Local Expenditure.*

This paper was followed by one on *The Standard, or Basis, of Taxation*, by Mr. CLAIR J. GRECE, LL.D.

Mr. G. HURST said these papers had brought before them one of the most important subjects they had to deal with, viz., the subject of Taxation. He considered that taxation ought to be strictly as Adam Smith laid it down, viz., that every one should contribute according to their means. All taxes should be levied in proportion to people's means, and indirect taxation would then fall upon the multitude. They could not reach the labouring man except by indirect taxation.

Mr. W. BOTLY, of London, thought they should do everything to encourage the outlay of expenditure by those who had the means to do it in anything that was useful and good to the country.

Dr. SHAW said they were now nearer the possibility of a Tariff Commission than they had been for some time past in America. He also pointed out that Protectionists and Free Traders were not so bitterly opposed to each other. Most of them, who were Economists, did not regard themselves as Free Traders or Protectionists; they were rather Economic Opportunists.

The CHAIRMAN explained, with regard to his own paper, that his object was to detail particular taxes, and not to go into the policy of the Local Government Bill.

A paper on *The Suitability of Small Towns for Factory Industries*, by Mr. RUSSELL R. TANNER, was then taken, after which the section adjourned.

MONDAY, SEPTEMBER 10TH.

Mr. R. H. INGLIS PALGRAVE, F.R.S., presiding.

Professor EDGEWORTH, F.R.S., read the report of the Committee appointed to investigate *The Best Method of Ascertaining and Measuring Variations in the Value of Monetary Standard*, and Mr. S. BOURNE followed with a paper on *The Use of Index Numbers.* The Committee in their report stated that the main practical uses for which the measurement of variations in a monetary standard have been desired are (1) the fixation of rents or other deferred payments extending over long periods of time, for which it has been desired to obtain a currency of a more stable sort than money was supposed to be; (2) to enable comparisons to be made between the value of money incomes in different places; and (3) to enable historians and other students making comparisons between past and present to give approximate meaning to the money expressions with which they deal, and say roughly what a given fine, or payment, or amount of national revenue or expenditure in a past age would mean in modern language.

The Rev. G. HURST said the establishment of an index number with regard to our commerce was a matter of very great importance, but it should be remembered that while they had an index number with regard to the exports, it was imperfect as far as foreign trade was concerned.

Mr. MACNIGHT said it appeared from what had been said that the trade of this country was on the increase instead of decrease, and he hoped Mr. Bourne would be requested to continue his researches.

Professor EDGEWORTH next read the report of the Committee appointed for the purpose of inquiring and reporting as to *The Statistical Data Available for Determining the Amount of the Precious Metals in use as Money in the Principal Countries, the Chief Forms in which the Money is Employed, and the amount annually used in the Arts.* Failing to complete their task, the Committee recommended their reappointment in order to institute further investigation.

In the absence of Mr. G. B. LONGSTAFF, the following paper on *Reasons for a Quinquennial Census* was read by Mr. PRICE.

An exact knowledge of the population is mainly useful as a basis for the calculation of birth-rates and death-rates. In England much money is expended on the calculation and publication of these in the various reports of the Registrar-General and the Medical Officers of Health. These reports are of great value in impressing the need of sanitary improvements on the people and the sanitary authorities, but they lose much of their value from the uncertainty as to the basis upon which such statistics must be built, viz., an exact knowledge of the population. Experience has proved that the official estimates and the census numbers often differ by 10 per cent. in either direction, and sometimes by 15 or even 22 per cent. The Registrar-General himself is ceasing to put any trust in the official estimates of populations, as shown by recent weekly and quarterly reports.

There is reason to believe that, mainly owing to unusually large emigration, the population of the whole United Kingdom was, in April, 1886, or five years after the census, between 400,000 and 500,000 *less* than the official estimate, an error of $1\frac{1}{4}$ per cent.; in smaller areas the errors are often, proportionately to the whole, very much greater.

These errors in the estimation of the population may involve an error of two or three per thousand in the death rate, so that elaborate calculations made with a view of correcting errors due to differences in age and sex, and constitution of the population, are thrown away.

Major P. G. CRAIGIE, F.S.S., London, said the subject was one of distinctly practical interest, and he hoped the Economic Section would take definite and immediate action in the matter. Anyone who followed the debates in the House of Commons on the Local Government Bill, or who had thought out the question of boundaries, could hardly have done so without coming to the conclusion that Dr. Longstaff had asked them to do something which they should lose no time in setting about.

Mr. BOURNE bore testimony to the value of having figures closer up to date in all cases of research, particularly in England, where they had not only to deal with the increase of population, but with migration from one portion of the country to the other.

Surgeon-Major INCE pointed out the importance of knowing exactly the precise number of men, women, and children inhabiting this portion of the earth, and strongly suggested that instead of recommending a quinquennial census, the British Association should press upon the Government that the duties of the Registrar should be so extended as to include this. It appeared to him that the name of every person in every district should be known; every police superintendent should know who came into his district and who left it.

Mr. SHAW spoke of the need that existed in the United States for a comprehensive and quinquennial census. Some sort of understanding should be arrived at, so that the leading nations of the world could gather in their statistics at the same time and by the same process.

Mr. T. H. ELLIOTT, Recorder of the section, advocated the continuity of administration.

The discussion was continued by Major-General BABBAGE (Cheltenham) and Professor EDGEWORTH, after which a motion was carried to the effect that the Government should be memorialised in favour of the establishment of a permanent census sub-department, taking the census of the United Kingdom every five years.

Mr. L. C. PROBYN read a paper on *The Effects on Indian Exports of the Fall in the Gold Price of Silver.*

Mr. W. T. HARRIS followed with a paper which examined into *The Reasons of the Price of Wheat Rising and Falling Contemporaneously with the Variation in the Value of Foreign Currencies.*

Professor EVERETT (Belfast) explained that the rise in the price of gold had found its expression by a sweeping fall all round in price. It was that great fall in price which had brought agriculture into the most disastrous condition in which it was now found. It had also inflicted serious injury upon the cotton manufacturers of this kingdom. It was in the interest of all classes that the difference between these two kinds of money should be removed, and that the common level of exchange should be restored.

Mr. E. J. WATHERSTON (London) observed that the Government of India lose for every penny reduction in the price of silver one million sterling. One remedy was bi-metallism, which was not, however, in the range of practical politics. A gold standard for India was improbable, but there was one remedy, which was to put silver in this country upon a completely free trade basis. It was in the highest degree impolitic to retain any obstacles to the consumption of the raw material for manufacturing purposes. The duty on silver plate should be abolished, and hall-marking made a voluntary institution.

Mr. EOTLEY and Professor EDGEWORTH having spoken,

Major-General BABBAGE expressed his belief that silver had decidedly depreciated owing to excessive production.

Mr. W. L. HEYES followed with a paper on *Statigrams*—in other words, a diagram to enable the public to more readily appreciate and grasp statistics, and to increase the value of greater uniformity in the graphic representation of statistics.

TUESDAY, SEPTEMBER 11TH.

Mr. INGLIS PALGRAVE presiding.

A paper on *Leasehold Enfranchisement* was read by Mr. J. G. RHODES, F.S.S., in the absence of Mr. CHAS. HARRISON, by whom the paper had been prepared. The author pointed out that practically the whole of the land on which the metropolis had been developed was formerly held by the Crown, by bodies ecclesiastic and corporate, or by a few great historical families.

Mr. ELLIOTT (Recorder of the section) pointed out that the acquisition of small property in town districts was at present to some extent forestalled. The system at present in use tended not only to perpetuate a monopoly of land-owning, but to create a monopoly of house-owning. Eventually they would have to face a great social problem, and its effect upon the working classes would be serious and damaging.

Mr. HANDEL COSSHAM, M.P. (Bristol), said the direction reform should take was very much open to discussion and argument. The Bill the details of which had just been read did not go as far as they would have to go. He was confident that the present system prevented the encouragement and development of thrift. They wished to encourage the acquisition of property by every legitimate means. The present law was one of the greatest barriers they had for the promotion of thrift and the development of healthy dwellings.

Mr. JOHN GEDDES (Southport) dwelt on the anomalies of the present leasehold system.

Mr. W. J. HARRIS, speaking as a London landowner, said this was an evil system, and he was perfectly willing to see it rectified in a fair and proper manner, with full compensation to those who held ground-rents.

Mr. ROWLANDS, M.P. (East Finsbury), contended that owing to the land in many places being in the hands of one or two landlords, they had a system of monopoly, and the ground landlord inflicted on a neighbourhood whatever terms he liked, and those who were bound, on account of their occupation, to reside in that area had nothing to do but accept the terms or go elsewhere.

Mr. SHAW (U.S.) said the experience of England in this matter would teach American legislators a great deal, and they could not be too prompt or too vigorous in legislating to check its growth.

Mr. RHODES, in reply, remarked that in the year 1930, which was the centenary of the Reform Bill, there would be a ground landlord who would own in London, unless some modification were instituted, no less an income, arising from a residential area, than £5,000,000. The monopoly should be revised.

The report of the Committee, consisting of Dr. J. H. Gladstone (Secretary), Professor Armstrong, Mr. Stephen Bourne, Miss Lydia Becker, Sir John Lubbock, Bart., Dr. H. W. Crosskey, Sir Richard Temple, Bart., Sir Henry E. Roscoe, Mr. James Heywood, and Professor N. Story Maskelyne, appointed for the purpose of continuing the inquiries relating to *the Teaching of Science in Elementary Schools*, was then read.

Mr. EDWARD J. WATHERSTON (London) next read a paper on *The Industrial Education of Women Abroad and at Home.*

Miss HELEN BLACKBURN read a paper upon *Irishwomen's Industries.*

Mrs. PALMER HALLETT said Miss Blackburn's paper touched upon the highest question of political economy. All the efforts referred to had been made by ladies of the landlord class.

Miss SHARMAN CRAWFORD, as one who had been intimate with the people in the South of Ireland for twenty years, said she had every reason to speak well of their industry and honesty. They could only compete with machinery by people working for starvation wages.

The discussion was continued by Mr. STOOR.

The following papers were then read :—

Economy in Education and in Writing. By Mr. EIZAK PITMAN, Bath.

Education: a Chapter of Economics. By Mr. T. W. DUNN, M.A.

Agricultural Education. By Professor JAMES LONG.

MECHANICAL SECTION.

(*Continued from p.* 271.)

SATURDAY, SEPTEMBER 8TH.

Dr. POLE, F.R.S., presiding.

Mr. J. GORDON (for Mr. Siemens) read a paper on *Rolling Seamless Tubes from Solid Bars or Ingots, by the Mannesmann Process*, of which the following is an abstract :—

The author referred to the circumstance that steel and toughened glass, though specially suitable, on account of their high qualities and strength, for use in the arts, had been somewhat neglected, owing to the difficulty of welding and cutting them. Attention was next drawn to the combination of strength with lightness which the tubular form admits of, and to the extensive use of tubes in construction which is likely to follow from a simple means of producing them. The different kinds of rolls hitherto employed, which are classed as the longitudinal, circular, and intermediate, were passed in review, and the process which forms the subject of the paper was then described. In the Mannesmann process a certain relation between longitudinal and rotary motion is maintained, so adjusted or each material to be worked, that a twist is imparted to the fibre resulting in great strength and toughness of the manufactured product. The following was the mode of manufacture : A bar is placed between conoidal rolls, where the diameter and therefore the velocity are least, and is gradually drawn forward into contact with those portions of the rolls which travel more and more rapidly. The rolls are so set that the space left between them for the passage of the bar decreases slightly, so as to cause a certain amount of material to be shifted. The action of the rolls preventing this material from being taken from the outside of the bar, it is consequently drawn from the interior, a hollow being first produced, and then a tube. A mandril may be employed to finish and smooth the interior and to enlarge the diameter of the tube. That the mandril is not required in the manufacture is proved by stopping the action of the rolls while the bar is passing through them, and breaking off the bar where the hollow is just commencing to form; the metal inside is found to be crystalline and bright, as before being cut there is a vacuum within the hollow, no air, of course, entering during the process of manufacture.

Several questions having been asked—

Sir FREDERICK BRAMWELL, F.R.S., spoke in favour of the adoption of the process, as possessing special advantages from a commercial point of view.

Colonel CUNNINGHAM, R.E., and Professor HELE SHAW, M.Inst.C.E., continued the discussion, and at its close Mr. GORDON replied, giving further explanations in answer to inquiries which had been made, menti oning, amongst other things, that the result of a frequent testing had been very satisfactory.

An interesting paper on the subject of *Gaseous Fuel* was read by Mr. J. EMERSON DOWSON, M.Inst.C.E., who explained that at the York Meeting of the Association in 1881 he described an apparatus for making cheap heating-gas by passing steam and air through incandescent fuel. Since then the apparatus has been considerably improved, and the gas made in it has been much used, not only for driving engines, but for heating in many industrial processes. The composition of the gas necessarily depends somewhat on the quality of the coal used and on the condition of the fire; the average composition is much the same whether the gas is made at the rate of 1,000 cubic feet per hour in a small generator or at the rate of 15,000 cubic feet per hour in a large one. In 1881 it was necessary for gas-engines to use five volumes of this generator gas for one of ordinary lighting-gas to develop the same power; since then some important modifications have been made in the Otto engines, and it is now necessary to use only four volumes. In 1881 only one engine of 3½ horse-power had been worked with the author's gas, but since then a large number of engines have been worked with it, one indicating over 80 horse-power. For more than four years Messrs. Crossley, the English makers of the Otto engines, have used this gas exclusively at their works for an average of 150 horse-power, and after a careful trial, extending over thirty-five weeks, they found that the fuel consumption was only 1·3 lb. per indicated horse-power per hour. At these large works there is no chimney except for the blacksmith's shop. Returns sent by eleven users of Otto engines working regularly in different places with the author's gas, and averaging 35 horse-power each, show an average fuel consumption of about 1·3 lb. per indicated horse-power per hour, which is less than half that required for the best steam-engines of equal power under ordinary working conditions. The results of other tests are given and seeing that all have been obtained under practical working conditions, the record is certainly satisfactory. Many letters have also been received testifying to the ease with which the gas plant can be managed. The author considers himself justified in saying that gas-power is now fairly launched in competition with steam-power, and he thinks, with the late Professor Fleeming Jenkin, that eventually the former will to a great extent supersede the latter. The results already obtained with this gas are good, but the author thinks it tolerably sure that even better results will be obtained when an engine is really designed to give the best effect with generator gas. It is well known that in the Otto engines each new charge of gas is diluted with a portion of the products of combustion from the previous charge, and this answers very well for ordinary lighting-gas. But as generator gas, such as the author's, has only about one-fourth the explosive power of the other gas, it is a disadvantage to dilute it with products of combustion, and he feels confident that sooner or later makers of engines will find it expedient to design all engines of large power specially for cheap generator gas. The best fuel to use for making the gas is anthracite, as it does not yield tar or other condensable products, and does not cake in the generator. Ordinary gas-coke can also be used with certain precautions.

Several instances are given of the use of this gas for heating of various kinds. At the Gloucester County Asylum it has been used daily for about five years. All the kitchen work for the staff and inmates is done with it, and there is no ordinary fire in the kitchen; about three hundred quartern loaves are baked with the gas every day, at a cost of about one shilling only for fuel. The gas is also used for two 12 horse-power (nom.) Otto engines, which pump water and drive a dynamo for electric lighting.

On the Continent several firms use this gas for singeing silk yarns and textile fabrics. It is also used by several linen manufacturers in the north of Ireland for stentering, which they formerly did with hot air. The cost of the gas somewhat depends on that of the fuel; but speaking generally, the equivalent of 1,000 cubic feet of ordinary lighting-gas costs from sixpence to one shilling.

Sir FREDERICK BRAMWELL said the subject dealt with in the paper was one in which he was much interested, for any invention which tended towards the method of driving engines by heat instead of by steam was most desirable. In his paper the author had alluded to some statements he (Sir Frederick Bramwell) had made in his address as President to the members of the Institution of Civil Engineers, and they were certainly very striking. He deplored the fact that in consequence of coal and slack being so cheap, people were indifferent to any proposal to substitute an improved method of using it. To him it was a terrible thing that they should be wasting by the extravagant use of coal the inheritance of those who were to come after them, and he therefore thought that anything which could be done to put a stop to it ought to be encouraged. The writer of the paper had hardly given credit to the steam-engine trials which he had referred to in his address the other evening. There was no doubt the engine was in the best order on that occasion, and it was worked by a very skilled person, who did not hesitate to display his great interest in the trial by turning up his sleeves and himself performing the duties of stoker. He (Sir Frederick) thought that the theory of the gas-engine was a good one, and that its results when worked with cheap gas would be satisfactory he did not doubt. In proof of this he had recommended its adoption instead of steam in a case where it was very desirable to reduce the fuel consumption. He looked forward most hopefully to the outcome of the subject brought before them.

Mr. FLETCHER asked Mr. Dowson whether he had contemplated the possibility of saving the ammonia which would be obtained in carrying out the system he had described.

Major-General WEBBER, C.B., who said he had watched the progress and development of the matter in question with considerable interest, did not think Mr. Dowson had given himself sufficient credit for the results he had obtained. He had worked in the direction of reducing nitrogen to a minimum without increasing the expense of manufacture. In this process of manufacture the apparatus converted the three fuels coal, water, and air into the results which were given in the analysis. He had not attempted to get rid of nitrogen, but to obtain the maximum quantity of hydrogen, and he was very much to be congratulated upon the effective mode he had adopted for the purpose. He might justly be called the pioneer of gaseous fuel. In Paris in 1881 one of these generators was at work under the gallery during the whole of the Exhibition, and it was not considered a source of danger, nor yet of inconvenience, to the number of valuable exhibits by which it was surronuded. The idea that danger would result from placing the generator in the basements of buildings in our towns was, therefore, entirely got rid of. The speaker described the successful manner in which an engine driven by this gas worked electric light machinery by night and farm machines by day, in a country place where the expense of coal was too great for steam to be used. Such a success as this was, in his opinion, worth all the written evidence which could be placed before them.

Professor HELE SHAW said that when the system was first described at the British Association meeting at York, in 1881, he asked a question as to whether if gaseous fuel were used for domestic purposes serious danger might not possibly result where carbonic oxide was used in large quantities. Mr. Dowson then replied that he proposed, when using it for such a purpose, to adopt means to enable the presence of carbonic oxide to be detected. This was another example of preconceiving a danger which might never happen, for they had now the experience of several years at the Gloucester Asylum and elsewhere to show that no inconvenience resulted, and he congratulated Mr. Dowson on the result. He felt certain that Mr. Dowson had given his figures honestly. He had also always stated that for an ordinary boiler this gas should not be used. The suggestion that gas should be generated in the boiler itself was a valuable one, and suggested a new departure. Water-gas would then be employed in a most satisfactory and economical manner. He asked for information as to the probable aggregate horse-power of the engines now working with the author's gas.

Mr. WILLIAMS asked whether any instances had been met with in which danger had resulted from the use of this gas. The danger from carbonic oxide was very great, and he had read of instances in which it had caused death without there being any smell or other indication of its presence. He understood that in the United States its manufacture was on this account restricted by the law in several parts of that country.

Mr. DOWSON, in replying, said he would be extremely sorry to be in any way unfair to the steam-engines. All he desired to do was to point out the different conditions under which they worked when on trial and on ordinary occasions. Experimentally, when he had worked the gas apparatus himself, he had brought down the consumption of fuel to 1·1 lb. per indicated horse-power per hour, but he had preferred to give the examples mentioned in his paper, as they referred to engines doing practical work under ordinary conditions. He thanked General Webber for his appreciative remarks, but must be careful not to take more credit than was his due. Sir William Siemens was unfortunately no longer with them, but it must not be forgotten that it was mainly due to him that the question of gaseous fuel had come prominently forward in this country. In answer to Mr. Fletcher's question as to the recovery of ammonia, he said he had not given the subject any serious thought. The quantity of ammonia was infinitesimally small when anthracite coal was used, so that it would hardly pay to recover it. Mr. Dowson proceeded to say that he knew of no one injured by this gas, and that it was no doubt a satisfaction to find that in such an institution as the County Asylum at Gloucester, which possessed a competent medical staff, who were necessarily exacting about the hygienic conditions, the use of this gas had been carried on for five years without any trouble at all having occurred. In concluding, Mr. Dowson acknowledged that there was a danger in the use of carbonic oxide, as there was also in using gunpowder, electricity, and other things if they were improperly handled. All that was necessary was to recognise the danger, and then take precautions accordingly.

The PRESIDENT expressed his deep interest in the matter under discussion, and congratulated Mr. Dowson on the success which had attended his investigations. He added that up to the time of his death the late Sir William Siemens was actively engaged on the subject, and the prize given by him at the Smoke Abatement Exhibition for the best method of utilising fuel was awarded to Mr. Dowson.

MONDAY, SEPTEMBER 10TH.

Mr. W. H. PREECE, F.R.S., presiding.

The special subject for the day's discussion was *Applied Electricity*, and the first paper was read by Mr. W. ANDERSON, M.Inst.C.E., upon *The Application of Electricity to the Working of a 20-ton Travelling Crane.* One of the travelling cranes in the foundry of the Erith Ironworks was originally constructed to be worked by hand, but preparations had been made to apply wire rope driving at some future time.

The crane is 39′ 6″ span, and consists of a pair of wrought-iron girders resting on end carriages running on an elevated line of rails. The gearing for hoisting longitudinal and for cross traverse is secured to the top of the main girders; the hoisting chain passes from the barrel at one end over a pulley at the other, then back to the pulleys in the cross traversing carriage, which runs between the main girders, through a falling block, and thence to an anchorage under the barrel at the extreme end of the main girders. By this arrangement the crane occupies a moderate height, and the hook can come within three feet of each wall.

The inconveniences and wear attending the employment of rope-driving gear induced the writer to try whether electricity might not be used with advantage. Messrs. Elwell Parker, of Wolverhampton, were communicated with, and these gentlemen undertook to supply the dynamo and a motor suitable for the peculiar requirements of a heavy crane. The dynamo, which was intended to give 50 ampères at 120 volts with 1,200 revolutions, was fixed in the main boiler-house of the works, and was driven by a small horizontal engine by means of a link belt. The leads from the boiler-house up to the conductor in the foundry are of 6 B. W. G. copper wire, while the conductor is formed of an angle-iron bar $2'' \times 2'' \times \frac{1}{4}''$, extending the whole 350-feet length of the shop, and has one face roughly ground and protected from rust by vaseline. The return current travels along one of the rails on which the crane runs. The motor, which is shunt wound, and constructed for 100 volts and 50 ampères, is fixed on the working platform of the crane beside one of the main girders. Its driving spindle carries a steel pinion which gears into a double helical spur wheel keyed on to a shaft which runs longitudinally on the top of the girder, and is connected by nests of three bevel wheels, with friction clutch connections to the three shafts which command the several movements of the crane, the means of using the hand-power being still retained.

Two sets of speeds are arranged for each of the movements, namely—

Hoisting .	. slow 3·4 ft. per min.,	fast 10 ft. per min.
Cross traverse .	,, 25 ,, ,,	,, 105 ,, ,,
Longitudinal traverse	78 ,, ,,	,, 213 ,, ,,

To provide against undue strains upon the motor an automatic magnetic cut-out is fixed on the crane, and for the purpose of varying the power and speed to meet the requirements of the foundry a set of resistance coils is provided, governed by a special switch by means of which different resistances can be introduced into the armature circuit of the motor, or the current can be cut off altogether, but so that it must be done by steps, and not suddenly. The connection between the motor and the conductors is by means of brushes pressed against them by elastic attachments. The handles for operating the several movements, the break lever, the switch, and the automatic cut-out are all collected together, so that a single attendant can readily work the crane from one spot.

The crane was set to work in June last, and has continued to act satisfactorily ever since. The advantages are very great in the facility of adaptation, as it is so easy to transmit the power from any point. The main boilers being always under steam, the crane is available at a moment's notice. The duty realised is about sixty-five per cent. of the power developed in the driving steam-engine. As far as can be judged at present, there is no special wear to apprehend. The conductors act satisfactorily, though a considerable length is in the open air, and the dust, heat, and smoke of the foundry do not appear to affect the working.

When first proposed, the writer was not aware of the existence of any other electric crane, but he has since learned that Messrs. Mather and Platt, of Manchester, have had one working satisfactorily for some time, and that there is one also in France.

A brief discussion followed. Several members, including Mr. J. L. STOTHERT and Sir FREDERICK BRAMWELL, F.R.S., asked questions as to the details of the working of the crane, and in reply Mr. ANDERSON said he thought there was not a weak point in it. The crane worked perfectly well, and without the least trouble.

In the absence of Mr. R. E. CROMPTON (owing to the sudden death of his eldest brother), Mr. GISBERT KAPP read that gentleman's paper upon *Recent Developments in Cowles's Aluminium Process.* The paper gave an account of the works erected at Milton, near Stoke-upon-Trent, and the writer stated that recent experience in America, at the works at Stockport, Ohio, showed conclusively that great economies were to be expected by increasing the size of the furnaces and the strength of the electric currents employed to work them, but no current larger than 3,000 ampères had been used up to the time the Milton Works were planned, where a dynamo giving a current of 5,000 ampères at 60 volts had been erected.

The discussion dealt principally with the details of the process which had been described by the paper, and Mr. KAPP, in his reply, stated that although he knew the cost of manufacturing aluminium at Milton, he was not at liberty to inform the section upon the point, but he might say it was exceedingly cheap.

Professor G. FORBES, F.R.S., read a paper upon *Electric Lighting in America*, drawing attention to the directions in which this industry had been developed in America. In landing in England they were particularly struck everywhere with the dimness of lighting in the streets. In America they could go to no single town without seeing abundance of arc lighting in the streets. He did not speak simply of the influential towns, such as New York, Philadelphia, or Boston; but in many out-of-the-way places in the most distant parts of the States, where gas had never penetrated, there the electric light had fixed its position, and was being used frequently; and not only the electric light, but other developments in the same way. But the progress made recently with arc lighting was not so striking to the Englishman as before, inasmuch as it was thoroughly established in America at the time of the British Association's visit to Montreal; but the progress had been with incandescent lights. The chief progress, he stated, in central station work had been in three directions—(1) arc lighting; (2) incandescent lamps with 3-wire system; (3) incandescent lamps with converters (Gaulard-Gibbs system). The number of arc lights was now about 300,000. The greatest progress had been by the work which Mr. Westinghouse had done in America. In electric lighting we in England had been stopped a great deal by what he might almost call the iniquitous Electric Lighting Act; and he regretted extremely, in the interests of the public and electric lighting generally, the Act passed this year, which had not yet put electricity on the same footing as gas. Those who had the matter at heart must regret that the Act had been passed, and so delayed the due recognition of the value of electric lighting. But he must say he did not think that the Electric Lighting Act was the only thing that had delayed their progress, because he saw that in electric traction and other developments of electricity the Americans had gone ahead with great energy indeed; and he certainly did not put it down to the want of capacity of our inventors. The best dynamo machines were all designed originally in England; the best arc lamps were in England; but with inferior machines and lamps in the States, he had noticed that they were determined, so long as the something they had would work well, to make it work well in the meantime, and to take up anything better whenever it might present itself. This go-aheadness was not in the inventor in the States, so much as in the men of capital who were also technically instructed—in fact, it was technical instruction which had developed enterprise in the States. Professor Forbes proceeded to detail some of the leading features of the Westinghouse central stations, and mentioned that there were at present 2¾ million incandescent lamps in use in the States. The general view, based upon experience in America, was that there was no danger of a breakdown ever happening in a properly organised station, with proper apparatus correctly laid down. He attributed a great part of the manufacturing success of American electric lighting plant to the fact that they fixed upon the types of machines they were going to make, they stuck to those types alone, laid down machinery enabling them to produce those types cheaply, and having thought out the system thoroughly at the beginning, they did not require to make a completely new type of machine for every order that came in. Thus they could manufacture their machinery cheaply, and in such a way that every part of the machine was replaceable.

Mr. H. EDMUNDS read the next paper, the subject being *A System of Electrical Distribution.* The author described the Edmunds system of electrical distribution, as now in actual use by the Cadogan Electricity Supply Company in London.

By this system groups of cells are placed in various portions of the district to be lighted, each group being divided into a given number of sections. If the group be divided into four sections it is arranged that three of these sections shall be sufficient to supply the local demand, while the fourth is being charged by a line from the central station. At given intervals the section which has been charged is removed from the main charging circuit, and switched into the local one, through which it discharges itself, its place in the charging circuit being taken by one of the other three, which, in its turn, is removed, and replaced by the next, and so on. Thus each section is kept charged, the charge never being allowed to fall below a certain point. Thus the great desideratum is achieved, viz., *constant supply*, quite independent of any accident on the line or at the central station. These changes are brought about automatically, by an instrument called a "distributor," consisting of a revolving shaft carrying cams, which in their rotation cause levers to rise and fall, and thus make and break the necessary contacts at the proper intervals. A polarised switch is attached, to prevent the current from entering the cells in the wrong direction, and also a voltage regulator, which keeps the batteries out of the charging main when they are fully charged, and connects them to it when they become exhausted, while a simple form of meter registers the amount of current consumed from day to day.

Mr. W. BAYLEY MARSHALL read a paper written by Mr. W. LOWRIE, upon *The Measurement of Electricity in a House-to-house Supply.* The paper described a method designed by the author and his colleagues for the purpose of measuring alternate currents as used for house-to-house distribution, with the converter system. As was well known, with such a system it was possible to get a current first in one direction, then in the opposite direction, and any chemical effect of the one current was destroyed in the reverse action. Messrs. Lowrie, Hall, and Kolle proposed to insert in the main an accumulator having an electric motive force of 2 volts. This electric motive-force during one-half alternation aided the ordinary current, during the other half opposed it. Thus, if the original electric motive-force was 100 volts, this became, when aided, 102 volts; when opposed, 98 volts. If, then, there were a deficiency in the circuit deposition would at one time take place, due to the electric motive force 102 volts, and during the reverse action only 98 volts, leaving the action of 4 volts over one-half the time—that is, of 2 volts over the whole time; and that gave the means of exact measurement as required.

The three papers were taken together for the purposes of discussion, and the CHAIRMAN said the system of measurement as described by Mr. Lowrie was actually in use at the present time, but it had been kept very quiet. He was rather afraid that it was difficult to derive information from the paper, but it appeared to him that there was the basis of a system which gave some accuracy of measurement and was novel.

Sir WILLIAM THOMSON, who was indistinctly heard at the reporters' table, alluded to the great cost of accumulation which must be taken into consideration. If the 50 volt lamps had stronger durability that would be an important matter, but it would not be sufficient to determine them if the whole cost of renewing 100 volt lamps was small. In all other respects the 100 volt lamps were the more convenient.

Mr. SELLON, Mr. S. WALKER, Major-General WEBBER, and Mr. KAPP continued the discussion.

Professor FORBES agreed with Sir William Thomson's remarks respecting the accumulators; they were working extremely well, but unfortunately they were still too costly.

In proposing a vote of thanks to the authors, the CHAIRMAN said he desired to protest against the idea that the inaction in this country was solely due to the Electric Lighting Act of 1882. That Act was in no sense or shape an interference with the action of corporations. Some fifty or sixty corporations obtained Provisional Orders under the Act of 1882, but never carried out the provisions of those orders. The fact was that the system of electric lighting had not even yet become sufficiently advanced for corporations to justify themselves in investing the money of the ratepayers in electric lighting. It was impossible not to be impressed with the wonderful activity of the Americans, but he considered that in this country it was best to work slowly and with certainty, as was being done at the present time. In a year or two they would be able to learn all that was necessary in England, and they would go ahead and establish a system infinitely better than anything now existing. He should make it his duty to recommend to the Institute of Electrical Engineers to appoint a strong committee, to take into consideration the relative advantages of the 100 volt and 50 volt lamps, but he was himself favourable to the 100 volt.

Mr. R. PERCY SELLON read a paper upon *Electric Light Applied to Night Navigation upon the Suez Canal.* The author said that the largely increased traffic since 1878 gave rise to inconveniences and resulted in frequent delays. Hence shipowners put pressure upon the Canal Company to afford facilities to cope with the increased traffic. In 1885 the average time occupied in passing through the Canal (eighty-seven geographical miles long) amounted to from forty to forty-five hours.

To meet the general demand the Canal Company introduced various improvements, and in the year 1884 commenced experiments to determine the practicability of navigation during the night by means of the electric light.

Owing to difficulties incident to the case, these experiments occupied two years, resulting in an authorisation issuing from the Canal Company in December, 1885, permitting vessels of war and mail boats to navigate some portion of the Canal if provided with suitable electric lights.

In April, 1886, the s.s. *Carthage*, of the Peninsular and Oriental Steam Navigation Company, for the first time made the prescribed passage by night successfully, followed shortly by others.

The success of these results encouraged the Canal Company to extend the authorisation to vessels of all classes, and to throw open the whole length of the canal to them; and in February, 1887, this authorisation was made public, subject to certain regulations laid down by the Canal Company.

Mr. FRANK BRAIN, M.E., dealt with the subject of *Electricity as Applied to Mining*. This paper was written from the mining engineer's standpoint, briefly sketching the known applications of electricity to mine working up to the present date.

The writer regretted there was very little known to add to what had already been made public. He could not but express surprise that a power which it is apparent had now passed the range of experiment, and is developing itself economically and efficiently, should not have been made greater use of than appeared to have been the case hitherto.

Mr. NICHOLAS WATTS read a paper on *Miners' Electric Safety Lamps*, in which he described the following lamps: the Swan, the Schanschieff, the Pitkin, the Walker, the Portable Electric Syndicate's Lamp, and the Vaughton.

A paper by Mr. J. W. SWAN, on *An Automatic Fire-damp Indicator*, was taken as read, that gentleman not being present; and Mr. S. WALKER and Mr. CARPENTER joined in a very brief discussion on the three papers.

TUESDAY, SEPTEMBER 11TH.

The business of the section did not commence until twelve o'clock, owing to a joint discussion with Section A on *Lightning-conductors*.

Mr. W. ANDERSON, M.Inst.C.E., presiding.

Mr. E. A. COWPER opened the proceedings by reading a paper on *An Improved Seismograph*, remarking at the outset that in order to register the motions of the earth, N., S., E., and W., it was, of course, necessary to have a heavy weight as little as possible affected by the motion of the earth. Parallel motions, or "compound pendulums," had been used with good effect, but a simpler and more effective plan would be to place a heavy flat weight on a piece of glass with three small "steel bicycle balls" below, resting on another flat or slightly hollowed plate, so that when the vibrations of the earth ceased the weight would slowly return to its normal position. In place of glass plates, ground porcelain or metal plates might be used. The weight might be brought back to its normal position by a light pendulum, and then all the plates must be flat and of common plate-glass. Then two levers acted on from the centre of gravity of the weight, and multiplying the motions, would register, on long strips of paper, the vibrations, N. and S.' E. and W., the paper, of course, being driven by clockwork, and allowed to start as soon as the vibrations of the earth commenced. Then the vertical vibrations (which had always been the most difficult to obtain a record of) could be very thoroughly ascertained and recorded by the following simple arrangement: A light steel iron or steel tube, closed at the top, like a small gas-holder, was inserted in a tank of quicksilver, the centre space inside the gas-holder being occupied by an empty tube, so as to reduce the weight of quicksilver very materially. On exhausting the gas-holder with a "Sprengel pump" the tank would rise, owing to the pressure of the atmosphere below it, until the column of mercury balanced the atmosphere; thus the weight of the tank and mercury in it being, in fact, supported by the *atmosphere*, and the gas-holder being attached to the earth, might rise or fall, and yet scarcely affect the tank in any way, and a rod from the tank to a multiplying lever attached to the earth and recording apparatus would record the vertical vibration on a strip of paper moved by the clockwork.

Professor H. S. HELE SHAW read a paper, prepared by himself and Mr. E. SHAW, upon *the Friction of Metal Coils*.

A discussion upon details followed, in which Professor UNWIN, Mr. W. W. BEAUMONT, and the CHAIRMAN took part.

Mr. PERCY K. STOTHERT thought it might be of interest if he described the form of rope brake which had been applied to cranes of very large size—*i.e.*, fifty-ton concrete block setting-machines. Four lengths of three-inch circumference ropes were placed side by side and sewn together, and afterwards lapped round by spun yarn; one end of the band was attached to a fixed point on the crane, and the remainder passed four or five times round a cast-iron barrel on the second and third motton shaft; the other end being held in the crane-driver's hand, a very slight pull was sufficient to hold the full load, and an equally slight pressure in the other direction was sufficient to lower the fifty tons, the driver thus being able to lower at any required speed. The only objection to this method was that owing to the heat generated, the rope very soon burnt, and had to be frequently renewed, so he thought Prof. Hele Shaw's system of spiral springs could be applied to the lowering and suspension of these heavy bodies.

Professor M. F. FITZGERALD explained a number of *Steam-engine Diagrams*, and in the discussion several members expressed their opinion that he was pursuing his studies in a direction with most useful results.

Mr. W. W. BEAUMONT read a paper on *Efficiency of Steam at High Pressures*.

Professor UNWIN, Professor FITZGERALD, Mr. H. DAVEY, and others discussed the paper briefly.

Mr. H. C. VOGT dealt with the subject of *Revolving Sails, or Air-propeller*.

Several speakers characterised the scheme as a novelty, but agreed in the idea that it was thoroughly worthy of investigation.

The CHAIRMAN said he had determined to fit out a steamer in the manner described, in order to see the results which might be obtained.

ANTHROPOLOGICAL SECTION.

(*Continued from p.* 272.)

MONDAY, SEPTEMBER 10TH.

Lieut.-Gen. PITT-RIVERS, D.C.L., F.R.S., presiding.

A paper was read by Miss A. W. BUCKLAND on *Necklaces in relation to Prehistoric Commerce*. The object of this paper was to trace the geographical distribution of various forms of necklaces and beads, as indicating some sort of commercial intercourse between the races among whom they are found either in present use, or among the relics of the past.

Among the ancient cave-dwellers of Europe, teeth of men and animals, bored for suspension and intermixed with shells and pieces of bone, were used as necklaces, and similar necklaces are still worn by savages in almost all parts of the world; but in the Andaman Islands necklaces are made of pieces of human bone, and of bones of animals, not bored, but bound to cords, and wood is sometimes made to imitate bone. The same singular substitution exists in the Admiralty Islands, where also human bones are used as neck ornaments. Necklaces formed of discs of white, purple, and red shell, cut with much care and labour from large sea-shells, are used by natives all over America and across the various groups of the Pacific to Japan, China, and India, where they are worn by the Nagas. These shell discs, known in America as Wampum, form the money of the Red Indians, and are also used as money by the Solomon Islanders. Similar shell discs are found in ancient graves, not only in America, but in Europe; whilst in Africa, ostrich egg-shell discs of the same size and threaded in the same manner, with pieces of skin substituted for the dark shell, are made and worn by Bushmen, Niam-Niams, and other wild tribes in the interior. Similar ostrich egg-shell discs are found in ancient Egyptian and Etruscan tombs, showing prehistoric intercourse between Etruria and Egypt, or the interior of Africa.

The pendants accompanying these necklaces are almost always teeth or shells cut in the form of teeth. The beads used for necklaces and found among ancient relics are of various substances, such as bone, serpentine, gold, silver, bronze, tin and glass, and are often made so as to represent several discs or beads joined together. Beads of this kind are found in the Swiss lake dwellings, in Spain, in Britain, in Hissarlik and Mycenæ, and of a later date in Livonia and Abyssinia.

Beads of amber, which formed such an important article of commerce in prehistoric times, are found among relics of the Stone Age, and have also been discovered in tombs belonging to the Bronze Age, in all parts of Europe, in Egypt and India, several trade routes being known, whereby amber found its way from the Baltic to the Mediterranean. Of glass beads the most remarkable are those known as adder-stones, still used as a charm to cure cattle diseases. Beads of this kind of one particular pattern known as chevron beads have been found in various parts of Europe, in Great Britain, in Egypt, in the Pelew Islands, and also in ancient graves in Canada and Peru. Similar glass beads are dug up in Ashantee and highly valued, forming part of the royal jewels. Beads of the same shape, and from the markings upon them, probably of the same kind, appear adorning the necks of monarchs on the sculptured slabs brought by Layard from Assyria.

There is also a melon-shaped bead of various materials, very widely distributed, being found in ancient graves in Mexico, as well as in Assyria and all over Europe.

Many peculiar glass beads are found in Ireland, resembling those of Egypt and Greece, although perhaps of native manufacture copied from older types, and it may be fairly said that the history of necklaces is the history of commercial intercourse both in prehistoric and in modern times.

Major C. R. CONDER, R.E., communicated a paper on *The Early Races of Western Asia.*

Mr. J. THEODORE BENT discoursed on *Discoveries in Asia Minor.*

A note on *The Definition of a Nation* was read by Mr. J. PARK HARRISON, who said that he did not propose to go into the archaic meaning of the word "Nation," but simply to elicit an opinion as to the growing misuse of the term at the present day. He referred to the definitions by Johnson, Todd, and Latham, and also to that by Dr. Worcester, in the American Dictionary of 1881. They all, excepting Todd, omit any reference to race or language. As regards language, it is admitted by ethnologists that it is no test of race. Numerous populations are known to have entirely given up their own tongue and adopted the language of their conquerors. This was so with the earliest races in Great Britain and Ireland, when subjugated by the Kelts; whilst as instances of voluntary change of language, the Scandinavian people in Ireland, who at the time of the Conquest, were found to be a third of the entire population, learnt Celtic, and styled themselves "Irish," an example subsequently followed by the earlier English settlers in Munster and other parts of Ireland.

The definition of the term nation in the dictionary of the French Academy also omits race and language, and is by far the best, and possesses the greatest authority. It is this—"The entire population born or naturalised in a country, and living under the same government." This definition applies to England as well as France, both of which countries contain a population composed of four different races, none of whom by themselves are, or ever were sufficiently numerous in either country to constitute a nation.

There is consequently no Saxon, Danish, Keltic, or Iberian nationality in the British Isles. The several races were merely offshoots of great nations. Their proper nationality was lost when they separated from the parent stocks—very much as individual emigrants lose their former nationality when they obtain letters of naturalisation in a foreign country.

Sir JOHN LUBBOCK said it was convenient to speak of the people of our country as English, but as a matter of fact they were an extremely composite race. In different parts the population was made up of elements in very different proportions. The East of England was ethnologically similar to the East of Scotland rather than to the West of England, and the West of England was ethnologically similar to the West of Scotland rather than to the East of England. In considering the qualifications of the race inhabiting these islands they found some were more Saxon, some more Celtic, others more Iberian in blood, but there was something in which the people of those islands differed from the Saxons, Celts, or Iberians of the Continent, and the reason of this was that they came in very small boats, and without women, and men of the tribe not unnaturally intermarried with the women of the island. The result was they had in this country a composite race entirely different from any other race in the world, except in their own colonies, where they found the race reproduced. He thought all the great races of the world had occupied this country with the exception of negroes, and one or two other races confined to the torrid regions. They saw cropping up amongst them even the Australian and the Mongolian types.

Dr. E. B. TAYLOR considered, as anthropologists, they wanted a more accurate sense in which they could use the words family, clan, tribe, nation, etc.

Professor SAYCE briefly dealt with the subject from a linguistic point of view.

Dr. J. BEDDOE deprecated the use of the word "nation" in an anthropological sense, as the definition belonged rather to politics than to anthropology, and these two they were not desirous of mixing.

Dr. EVANS and other gentlemen joined in the discussion, and the PRESIDENT said he thought they would all agree that a nation was a people who, having a great and glorious history, had the firmness and determination to maintain it.

Mr. J. W. BLOXAM, M.D., in the absence of the author, Mr. J. S. Stuart Glennie, M.A., read an abstract of a paper on *Pelasgians, Etruscans, and Iberians; their Relations to the Founders of the Chaldean and Egyptian Civilisations.*

A paper entitled *Notes on the Hyksôs, or Shepherd-Kings of Egypt,* was read by the Rev. HENRY GEORGE TOMKINS.

In the discussion which ensued, Professor A. H. SAYCE said he could no longer subscribe to the opinion that between the Hyksôs and the Hittites there could be any racial connection.

TUESDAY, SEPTEMBER 11TH.

Lieut.-General PITT-RIVERS, F.R.S., presiding.

The first paper read was by Miss R. W. BUCKLAND, on *King Orry's Grave, Isle of Man.* The authoress gave a description of a visit she paid last year to the ancient monument in the Isle of Man known locally as "King Orry's Grave," a name which was repudiated by antiquaries as misleading, but which having crept into guide-books, and even into archæological works, might perhaps be retained for the present. This monument possessed certain peculiarities, sufficiently uncommon to render it deserving of especial notice. It did not seem easy at present to trace the plan of the monument as described by Oswald, but the tall monolith remained in position, and some of the chambers, especially at the west end, were intact, although the covering stones were gone. The authoress, who also forcibly dealt with other monuments in the Isle of Man, contended that these monuments belonged to a date far earlier than that assigned to them by those who would refer them to King Orry and his successors.

A paper on *Sun-myths in Modern Hellas,* by J. THEODORE BENT, was then read. The author said, The personification of the sun amongst the peasants of modern Greece compares well with the legends of classical times; his beauty, power, and strength endow him with regal attributes, and he is supposed at night-time to seek his kingdom, and live in a palace where his mother tends upon him. We have also the Sun's wife and the Sun's daughter, and can compare the Macedonian legend of Heliojenni with the Homeric myths of Perse and her children Circe and Aïtes. The Sun, as messenger, may be compared with the words of the dying Ajax.

The connection between sun-worship and that of the prophet Elias is very marked in modern Greece. Elias looks after rain, and is the Greek St. Swithin. Churches to him are always found on sites of ancient temples to Apollo. The Macedonian ceremony of Perperouna has a connection with other prayers for rain offered up to St. Elias. In a MS. from Lesbos this idea of union between St. Elias and a power over the elements is clearly shown. Taygetus, in Laconia, shows too the same connection.

There is a connection between sun-worship and St. George; the κάρα fires are lit on his day, and the connection is noticeable not only in the islands, but in Macedonia, where a curious swing ceremony is performed on St. George's Day, in honour of the Sun's bride having been swung up to heaven on that day. Also there is a close connection between St. George and St. John, the universal day for lighting fires, on the eve of the summer solstice.

Mr. J. HARRIS STONE, M.A., F.L.S., F.C.S., communicated a paper on *The Ancient Inhabitants of the Canary Islands,* of which the following is an abstract: The author stated that the name *Guanche,* though generally used for the old inhabitants of all the seven islands of the Canary group, should properly be only applied to the ancient inhabitants of Teneriffe. The ancient inhabitants of these islands were ignorant of the use of metals, and up to 1402, when the conquest first began, had to all practical intents remained apart from the civilisation of that day. They were a branch of the great Berber race, and probably also a tribe of that white dolichocephalic race of cromlech-builders which at a very early period swept through Europe. Their connection with the ancient Egyptians was noticeable in many traits and customs. The ornamentations in caves and on pottery which the author had come across in his travels in each island of the archipelago were Egyptian in character. The method of embalming the dead, particularly the practice of removing the entrails by a slit made with the *tabona* and the wrappings of the corpse, was very similar to that employed by the lower class of Egyptian embalmers. Though the ancient inhabitants of all the islands had so much in common, there were so many specific differences in their languages, manners, and customs that the conclusion was almost forced upon the investigator that they must originally have been peopled by more than one tribe of the same race.

The author had examined a large number of skulls in collections in the islands, and found them very European in contour and general appearance. In a large proportion of those in the collections in the islands he had noticed a peculiar indentation in the frontal bone, usually the left, and to his surprise found that of the twenty-six skulls at the Royal College of Surgeons, no less than fifteen possessed this mark, and of these ten on the left frontal bone.

The ancient inhabitants are now quite extinct as a separate race, but the author in his travels had noticed several traits, manners, and customs of the present inhabitants which were clearly, in his opinion, derived from the old race. The food *gofio* and its method of making and eating; the number of cave dwellings and villages; the still prevalent inter-insular jealousy; the size and great physique of the men of the Purpurariæ; the confiding, generous, hospitable character of the Conejeros; the use of the vaulting pole; the general absence of bigotry and religious intolerance: the preference to this day of the Gomeros to carry baggage on the head; the abomination of butchers; the torchlight fishing; the method of laying-out the dead; the wit of the Palmeros; the cleverness with which buildings are constructed with stones without mortar; the honesty of the Canarios; the unusual beauty of the peasant-women, were points alluded to by the author in illustration of his assertion.

The position of women was considered at some length, the author bringing forward many facts to show that they held a far higher position in the social scale than was usual among ancient nations.

Canon TRISTRAM said he had listened to this paper with much interest, as he was just fresh from the Canaries, having spent twelve weeks there. He had paid considerable attention to the subject which had been brought before them by Mr. Stone. He agreed with the author in everything, except when he said the "Guanche" had gone. He must allow that the inhabitants of the Canaries were free from all the vices which characterised his countrymen, and possessed all the virtues they could not find in Spain. Who were the European aborigines? what were they? and did any of them remain? He thought, with Mr. Stone, many of them did remain, and though the land might be lost, yet the race was not. While in the islands he visited every village, and wherever he went he found the "Guanche" the most truthful and honest people in the world. In the three islands he visited he never heard a muleteer utter an oath. He could not agree with the author that there was the slightest Egyptian trace in the inhabitants of these islands. No more Egyptians, he thought, than negroes. There was not the slightest trace of their having heard anything of Christianity or Mohammedanism. In conclusion, he asked if any reason had been found why the ancient people of the islands did not use boats.

Other speakers followed, and the author, in answer to Canon Tristram, said he had thought over the question why boats were not used by the ancient people, but he could give no satisfactory reason.

The Rev. HENRY GEORGE TOMKINS discoursed on *Worlebury, an Ancient pre-Roman Stronghold at Weston-super-Mare.*

The last paper was read by Mr. F. HAVERFIELD, on *Pre-historic Objects Found at Broos, in Hungary, by Miss Von Torma.*

In connection with this section there was an anthropological laboratory for the use of members.

CUSTOMS OF SAVAGE RACES.

LECTURE DELIVERED BY SIR JOHN LUBBOCK, M.P., F.R.S., TO THE WORKING-CLASSES OF BATH.

THE subject on which I shall have the honour of addressing you this evening is one of such vast extent, that I shall make no apology for entering on it at once, without any introductory remarks. I do not propose to describe the arms or implements, houses or boats, dress or food of savages—all no doubt very interesting, but which time will not permit me to deal with. My object will rather be, if possible, to illustrate the mental condition and ideas of the lower races of men.

Our empire contains representatives of almost every race of men, and every stage of human progress. To understand their wants and ideas, is not only an intellectual exercise, but a political problem of great national importance. Even those who consider that man was civilised from the beginning, and who look upon savages as the degenerate descendants of much superior parents, must still admit that our own ancestors were once mere barbarians, and may find therefore much interest in this study; but it no doubt appears far more important to those who think that the primitive condition of man was one of savagery, and that the history of the human race has, on the whole, been one of progress. No one, of course, supposes that every people must necessarily progress; but those which do not advance will assuredly be replaced, sooner or later, by more worthy races. Nor certainly do our modern savages in all respects reproduce the condition of our ancestors in early times; on the contrary, even the Australians have now a system of complex rules and stringent customs which have grown up gradually, and cannot have existed originally; it does, however, seem that from the study of modern savages we can gain a fairly correct idea of man as he existed in ancient times, and of the stages through which our civilisation has been evolved. At the same time the study is by no means easy, because many things which seem natural and obvious to a savage appear to us absurd and inconsequential. Moreover, if we often find it far from easy to understand savages, they naturally have much greater difficulty in understanding us. All over the world nations on first seeing white men have taken them for ghosts or spirits. Our weapons, tools, animals, in fact all our belongings are at first a source of great wonder. An Australian tribe, for instance, when they first saw a waggon drawn by oxen were much puzzled as to what the oxen could be. It afterwards appeared that some thought they were spirits, because they had spears on their heads, while others maintained that they were the wives of the white men because they carried the burdens, which among Australians is the special duty of women. Again, the modes of salutation among savages are sometimes very curious, and their modes of showing their feelings quite unlike ours. Kissing seems to us so natural an expression of affection that we should expect to find it all over the world, yet it is unknown to the Australians, the New Zealanders, the Paponans, and the Esquimaux and other races. I mentioned this fact about the negroes in one of my books many years ago, never supposing that it would give any offence, and was surprised to receive a most violent anonymous letter from a negro of St. Domingo on the subject. He abused me in unmeasured terms, and ended by saying that he would like to drink my heart's blood. The Polynesians and the Malays always sit down when speaking to a superior: in some parts of Central Africa it is considered respectful to turn the back to a superior.

Captain Cook asserts that the inhabitants of Malliedo, an island in the Pacific Ocean, show their admiration by hissing; the Todas of the Neilgherry hills in India are said to show respect by raising the open right hand to the brow, resting the thumb on the nose; it is asserted that among the Esquimaux it is customary to pull a person's nose as a compliment; a Chinaman puts on his hat where we should take it off, and among the same curious people a coffin is regarded as a neat and appropriate present for an aged person, especially if in bad health. Among the Yombas of West Africa, who take great care of their teeth and scrub them well at least three times a day, an old tooth brush is regarded as a touching present, not being so much intended for actual use indeed, but rather as conveying a sort of implied message that as the sender took the greatest care of his teeth and used his tooth-brush continually, so his friend was also in his thoughts morning, noon, and night. (Gollmer, Jour. Anthr. Hist., 1884, p. 176).

A mistake made by Dampier led to very serious results. He had met some Australians, and apprehending an attack, he says, "I discharged my gun to scare them, but avoided shooting any of them, till finding that we were in great danger from them, and that though the gun had a little frightened them at first, yet they had soon learnt to despise it, tossing up their hands and crying pooh, pooh, pooh, and coming afresh with a great noise.

I thought it high time to charge again and shoot one of them, which I did." Thus this wretched savage lost his life because Dampier did not remember that pooh, pooh, or puff, puff, is the name which savages, like children, apply to guns.

Mr. Taplin, a missionary to whom we are indebted for an excellent account of the natives of Australia, tells a curious story of this kind against himself. He asked the native word for "sins," but as the Australians do not use the letter "s," but replace it by "th," they misunderstood him and gave him the word "*Yrothelum*" which means thin, and he used this for a considerable time before he found out his mistake. I must, however, let him tell it in his own words. "When," he says, "I asked the word for sin, they gave the one for 'thin,' and so I was led into representing that it was hateful to God for men to be thin: that they would be condemned for it. So they came to the conclusion that it was pleasing to God for people to be fat. In fact, I had been telling them that all lean people went to hell, and fat people to heaven." (Rev. G. Taplin, "The Narrinyeri. Account of the South Australian aborigines," page 86.) Some ideas, indeed, which appear to us inexplicable and fantastic, are very widely distributed. For instance, medicine; our system seems so natural: send for doctor, get prescription, pay him, take medicine. By no means. In some cases a sorcerer is sent for, who frightens evil spirits by making a noise. In others, a wizard comes with a charm on a board. In others, a doctor drinks his own medicine. In China, they pay the doctor while well.

In many parts of the world a man is strictly forbidden to speak to his mother-in-law. Again, probably every Englishman who had not studied other races would be astonished to meet with a nation in which, on the birth of a baby, the father and not the mother was put to bed and nursed; yet though this custom seems so ludicrous to us, it prevails very widely.

Commencing with the Abipones of South America, Dobritzhoffer says that "no sooner do you hear that a woman has borne a child than you see the husband lying in bed, huddled up with mats and skins, lest some ruder breath of air should touch him, and for a number of days abstaining religiously from certain viands; you would swear it was he who had had the child. . . . I had read about this in old times, and laughed at it, never thinking I could believe such madness . . . but at last I saw it with my own eyes." Other travellers mentioned the existence of a similar custom in Kamskatka, in part of China, in Borneo, in the North of Spain, in Corsica, and in the South of France, where it was called "faire la Couvade." The reason probably was that the father and child being regarded as intimately connected, it was supposed that any exposure of the one to cold, wet, or other unwholesome conditions would be injurious to the other.

Again, it might have been thought that forms and ceremonies were especially characteristic of civilised life; but here again the actual fact is the very reverse of what might have been not altogether unnaturally expected.

> "Custom hangs on them with a weight
> Heavy as frost, and deep almost as life."

The salutations, ceremonies, and legal proceedings of savages are, in fact, most tedious and complex. Eyre mentions that in their intercourse with one another the natives of Australia are extremely punctilious. Captain Burton states that the Egbas or West African tribe spend at least an hour every day in troublesome ceremonies and have a great variety of salutations suitable for every possible occasion.

Another subject on which savages entertain ideas different from ours is that of relationships. It used to be supposed that the original family was founded on the Patriarchal basis—that the father was lord and head of the family; and that the ideas of relationships were founded, like ours, on marriage and descent through the male line. We regard a child as related equally to its father and its mother. We make no difference between a father's brother and a mother's brother on the one hand; a father's sister and a mother's sister on the other. Recent researches, however, especially those of Bachofen, Maclennan, Morgan, and Tylor, have not only modified, but I must say, with all respect to the justly high authority of my friend, Sir H. Maine, revised our ideas on these subjects. Herodotus long ago observed that the Lycians "had this peculiar custom, wherein they resemble no other men, they derive their names from their mothers." So far, however, from this being peculiar, it is, as a matter of fact, very general. Among most savage races when a woman marries she does not become one of her husband's clan, but remains still a member of her own. Now, the children cannot belong to both. Consequently if they are regarded as belonging to the mother's clan, they cannot be included in that of the father. But among the lower races it is most usual that descent is traced through the mother. Hence a man's children do not belong to his clan, but his sister's children do; and hence again, what appears to us the singular anomaly that among many races a man's heirs are not his own, but his sister's children. But though in this respect the woman occupies an important position, she is, on the whole, greatly to be pitied. The Hindoo maxim "never strike a wife even with a flower" is, no doubt, comparatively speaking, of modern origin. In fact, the original idea of marriage was one mainly of possession. The wife was the property of the husband. In many cases, no doubt, she was a war captive. Hence, I have suggested, arises the very prevalent custom of marriage by capture. Originally a stern reality, it became to be a mere symbol. All over the world we find that even after all the arrangements have been satisfactorily and amicably concluded, the bridegroom makes a pretence of carrying off the bride by force. Thus in the Phillippine Islands, when a man wishes to marry a girl, her parents send her before sunrise into the woods. She has an hour's start, after which the lover goes to seek her. If he finds her and brings her back before sunset, the marriage is acknowledged; if not, it is broken off.

In some parts of Australia when a man marries, each of the bride's relations gives him a good blow with a stout stick, by way I suppose of a warm welcome into the family.

Among the Kalmucks of Central Asia, again, the marriage ceremony is very romantic. The girl is put on a horse and rides at full speed. When she has got a fair start the lover sets off in pursuit; if he catches her she becomes his wife, but if he cannot overtake her the match is broken off; and we are assured, which I can well believe, that a Kalmuck girl is very seldom caught against her will.

If time allowed I could show you that this idea of capture in marriage occurs almost all over the world. Hence no doubt the custom of lifting the bride over the doorstep, which occurs or did occur among the Romans, the Redskins of Canada, the Chinese, the Abyssinians, and other races. Hence also perhaps our custom of the honeymoon, and hence may be after a wedding, things are thrown, as McLellan has suggested, in mock anger after the departing bride and bridegroom. It is remarkable how persistent are all customs and ceremonies connected with marriage. Thus our bride cake, which so invariably accompanies a wedding, may be traced back to the old Roman form of marriage by confarreatio or eating together, and is found also in other parts of the world, as, for instance, among the Iroquois of North America. It must we know be cut by the bride, because it is the duty of the wife to prepare food for her husband.

The prevalence of marriage by capture naturally led to the impression that a woman who was captured was relieved of all responsibility. It was no part of her duty to resist—which would indeed have been useless. On the contrary, the very fact of her capture itself constituted a legal marriage. This, I have ventured to suggest, explains what would otherwise be a great difficulty, namely, the position assigned to Helen in the Iliad. From our point of view her acceptance of Paris as a husband would be a great blot on her character. Yet not only among the Trojans generally, but by the venerable Priam and the virtuous Hector, she is always treated with affection and respect. The point seems to me of interest, because it throws light upon what from any other point of view seems inexplicable in the great Greek epic.

Again, we recognise only one kind of marriage, but in many parts of the world there are two or more totally distinct kinds of marriage, in which the relation, rights, and position of the husband towards the wife are altogether different. On the whole, it is satisfactory to see that as races progress the position of woman rises too.

It has always seemed to me that one of the clearest proofs of the low mental power of savage men is that afforded by arithmetic. For instance, in no single Australian language is there any word for "five." They said, "One, two, two, one, two, two, many." The fingers are greatly used as a help in these simple calculations, and all over the world we find the word "hand" standing for "five" in reference to our five fingers; indeed, if we had had six we should probably have had a duodecimal notation, which would have been in many respects a great improvement on our present system. Even our own word "five" is a case in point, though it is so much worn by use that its original form is almost unrecognisable. The original Indo-European word for "hand" is found little altered in the Persian "Penze." In Greek "Penze" becomes πεντε, in German "funf," whence our "five." The Punjab is the country of "Five rivers" from *Penge* "five," and *ab* "water," a root which we find again in many Celtic names, as for instance in Aberdeen, Aberystwith.

As might naturally be expected, none of the lower races have made any great advance in art; they have in many cases made a beginning, and those beginnings are very far indeed from being without interest.

The earliest works of art which we possess are rude sculptures and drawings, some of them far from deficient in spirit, which have been found in caves in Western Europe, and which appear to belong to the period when the Mammoth and Woolly-haired Rhinoceros still lived in England. Some of them indeed clearly appear to be representations of the former animal.

Books and writing have always appeared very mysterious to savages—and no wonder. On one occasion a "missionary sent a native to one of his colleagues, with some loaves of bread and a letter stating their number. The messenger ate a part of the bread, and the theft was consequently discovered. Another time when he had to deliver four loaves, he ate two of them, but hid the accompanying letter under a stone while he was engaged, believing that his conduct would not be revealed this time, as the letter had not seen him in the act of eating the loaves.

The Minatarrees (a North American tribe) once seeing Mr. Catlin intent over a copy of the New York *Commercial Advertiser*, were much puzzled as to what he could be doing, but at length concluded that his sight was weak and that was a cloth for sore eyes. One of them eventually bought it at a high price.

(To be continued.)

NOTICES.

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METEOROLOGICAL RETURNS

For the ten weeks ending on Monday, Sept. 3rd, 1888. Specially prepared for SCIENTIFIC NEWS from official reports.

	Mean Temperature.	Rainfall.	Duration of Sunshine.
Scotland, East	53·7 degs., being 3·4 degs. below average.	7·6 ins., being 0·7 ins. above average.	286 hrs., being 90 hrs. below average
England, N.E.	54·9 ,, ,, 3·6 ,, ,, ,,	8·8 ,, ,, 2·8 ,, ,, ,,	235 ,, ,, 119 ,, ,, ,,
England, East	57·4 ,, ,, 3·9 ,, ,, ,,	8·1 ,, ,, 3·6 ,, ,, ,,	284 ,, ,, 143 ,, ,, ,,
Midlands ...	56·5 ,, ,, 3·8 ,, ,, ,,	8·3 ,, ,, 2·1 ,, ,, ,,	291 ,, ,, 101 ,, ,, ,,
England, South	58·2 ,, ,, 3·0 ,, ,, ,,	8·1 ,, ,, 3·0 ,, ,, ,,	297 ,, ,, 138 ,, ,, ,,
Scotland, West	55·1 ,, ,, 1·8 ,, ,, ,,	10·0 ,, ,, 1·1 ,, ,, ,,	300 ,, ,, 63 ,, ,, ,,
England, N.W.	56·1 ,, ,, 3·5 ,, ,, ,,	11·1 ,, ,, 2·8 ,, ,, ,,	276 ,, ,, 85 ,, ,, ,,
England, S.W.	56·9 ,, ,, 3·2 ,, ,, ,,	10·8 ,, ,, 2·9 ,, ,, ,,	353 ,, ,, 93 ,, ,, ,,
Ireland, North	56·2 ,, ,, 2·7 ,, ,, ,,	10·7 ,, ,, 3·2 ,, ,, ,,	264 ,, ,, 25 ,, ,, ,,
Ireland, South	57·0 ,, ,, 2·2 ,, ,, ,,	9·0 ,, ,, 1·7 ,, ,, ,,	335 ,, ,, 12 ,, ,, ,,
The Kingdom...	56·2 ,, ,, 3·1 ,, ,, ,,	9·3 ,, ,, 2·4 ,, ,, ,,	292 ,, ,, 87 ,, ,, ,,

Scientific News

FOR GENERAL READERS.

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CONTENTS.

SCIENTIFIC TABLE TALK.

By W. Mattieu Williams, F.R.A.S., F.C.S.

My visit to M. Agassiz—as the date indicates—occurred long before he left Switzerland for America, but I found that he spoke English freely. I was then the proud proprietor of a grand and decidedly original theory of the origin of mountains, and improved the occasion by submitting it to him.

I started my theory by assuming, in the ordinary gratuitous, matter of course fashion, that the earth was once an intensely heated sphere of fused matter, which has since cooled down and become solid. This being taken for granted as usual, my great deduction logically and necessarily followed. This was, that in such slow cooling of silica, the silicates, etc., would crystallise, and that the size of the crystals would be, and as we find they become in artificial crystallisation, proportionate to the whole mass and the slowness of cooling; therefore, when this world of ours first solidified, those parts of its surface where the quartzites and similar material prevailed, presented on a large scale a group of pyramidal eminences, corresponding to those we find on a small scale in drossy cavities and other places, where such material has been fused and slowly cooled. These pyramidal crystals were the great mountains of the earth.

This idea seemed to be confirmed by the fact that the highest mountains of the Alps, etc., were mostly composed of silicates, etc., with crystalline proclivities, and I had measured and recorded by means of a simple instrument the visual angles of a large number of the well-known "*aiguilles*" and summits of the Alps, many of which—such as the *Silberhorn* of the Jungfrau and the *aiguilles* of Mount Blanc—are remarkably geometrical and crystal-like in their form, and appearance. The first blow to my grand theory was presented by Mont Blanc itself, which instead of appearing as the master crystal of the group, is a rounded mass, its summit receiving the name of the "dromedary's hump."

This, however, I parried by making an ascent, and thereby learned that Mont Blanc actually has a similar structure to the pyramidal aiguilles around it, and that the rounded appearance is due to the snow that fills up all their hollows, leaving only the summits of the pyramids visible just above the snow such summits being the *Grands Mulets*, the *Rochers rouges*, etc., etc., that are seen in the course of the ascent.

I still believe that such is the real structure of this mountain, though I am not aware that it has been so regarded by any other observer.

Agassiz listened attentively to my exposition of the grand theory, used some complimentary expressions in reference to its ingenuity, etc., and then proceeded to demolish it by referring to what I saw around me, to the block on which we stood, and the material on the great moraine over which I had travelled that morning, all of which showed that even if such crystallisation had ever occurred the pyramids would have been obliterated by weathering and glaciation long ago. He admitted, however, the possible existence of something like crystalline cleavage planes having produced the curious uniformity that I had observed in the summit angles of different mountains composed of similar material.

This conversation showed that Agassiz at that time had strong faith in the potency of glaciation as a shaping agent of the earth's surface. Subsequent researches have justified this, so far as the Arctic and temperate zones are concerned.

The scene presented from the Hotel des Neufchatelois was very grand and characteristic. We stood upon a wide expanse of ice, having the appearance of a solidified river of great width, with great blocks of stones floating on its surface, some standing on stalks like gigantic mushrooms, others, as already described, forming the great ridge of the medial moraine.

Looking up the ice river, the bold wedge-shaped promontory of rock, the *Abschwung* formed the middle foreground, and diverging upwards from this were the two tributary ice streams of nearly equal width, the Finsteraar and the Lauteraar glaciers, which by their confluence form the *Unteraar* glacier, on the medial moraine of which we stood.

Rising from all sides of all these ice rivers were pyramids and pinnacles of snow-clad rock. Above the Lauteraar glacier were the many glistening peaks of the Shreckhorn (12,383 ft.) and the Lauteraarhorn. To the left above the Finsteraar glacier stood the massive Finsteraarhorn (14,106 ft.) and its snow-capped satellites, and on either side of the wider stream at our feet were similar peaks; nothing but frozen desolation visible everywhere around, although it was the 20th of August, and the sun-rays were painfully scorching, as so frequently is the case on the high Alps.

On one of these snow peaks, the one showing the fewest dark spikes of rock among the snow, thus presenting a cone of nearly unspotted whiteness, and named accordingly the *Point de Niege* or *Schneehorn*, we saw some dark moving specks like beetles crawling over the snow. This was a section of the students that had made the ascent, and were then on their way down. I was surprised on their arrival to see several Alpine flowers that they had collected from amidst this snowy desolation.

Presently they started again as our guides over the glacier, which differs materially from those that are more familiar to the Alpine tourist, those of Chamouni, Grindelwald, etc. These are in steeply sloping valleys and abound in crevasses, broken up angular masses of ice, and general irregularities. The Aar glacier, at the part chosen by Agassiz, and for a long distance both above and below, has but a small slope, and thus the action of the sun upon its surface has time to produce some of its characteristic effects, which in steeper glaciers become obliterated before they are fully developed.

One of the first of these that we were shown was a fine glacier table, a great block of stone perched upon a cone of ice. Originally this stone had fallen from one of the rock slopes flanking the glacier, and in its fall had been projected beyond the lateral moraine, so as to stand alone as a small island on the ice. In this position it shaded the ice immediately below it, which thus retained its original level while all around was thawing down. The block and pedestal as we saw it presented at a distance the appearance of a gigantic mushroom.

The time required for effecting a notable difference of level will be understood by the following:—Agassiz covered portions of the ice with different protecting substances, and observed the result at the end of 16 days. A piece of woollen cloth stood not quite 8 ins. above the naked ice; an umbrella made a difference of $8\frac{3}{4}$ ins.; a wooden plank, 11 ins.; a covering of turf, $11\frac{3}{4}$ ins., and of snow the same. Thus the general "ablation" or thinning down amounted to about 1 ft. in the 16 days.

M. Desor covered a space of 6 square metres with turf on 15th July, and on 13th September found that the glacier had sunk at an average rate of nearly $1\frac{1}{2}$ ins. per day. This of course varies with the season and weather.

We were shown how to obtain our bearings by means of a glacier table. The cone of ice on which it stands is irregular, the slope of one side much greater than that of the other. The longest slope is always on the north side and the steepest on the south.

The reason of this appears on a little reflection. The sun at midday is due south, and during its most vigorous working hours it is more or less southerly, and therefore casts a due north and northerly shadow. It is the shadow of the block of stone that protects the ice and forms the cone on which the glacier table rests.

For simplicity sake let us regard the work of the sun at midday. Being on the south side of the block, and below the zenith its rays must to some extent undermine the ice base, while the north side of the base is completely in shadow. This goes on until such undermining causes the block to topple over to southward, when it starts afresh to produce another glacier table. In this way a huge block may actually travel across a glacier. Agassiz saw one that was 15 ft. long, 12 ft. wide, and 6 ft. high, slide 30 ft. on falling. It reduced to powder the ice over which it passed.

GASEOUS FUEL.

A PAPER READ BY MR. J. EMERSON DOWSON, M.INST. C.E., BEFORE THE MECHANICAL SCIENCE SECTION OF THE BRITISH ASSOCIATION.

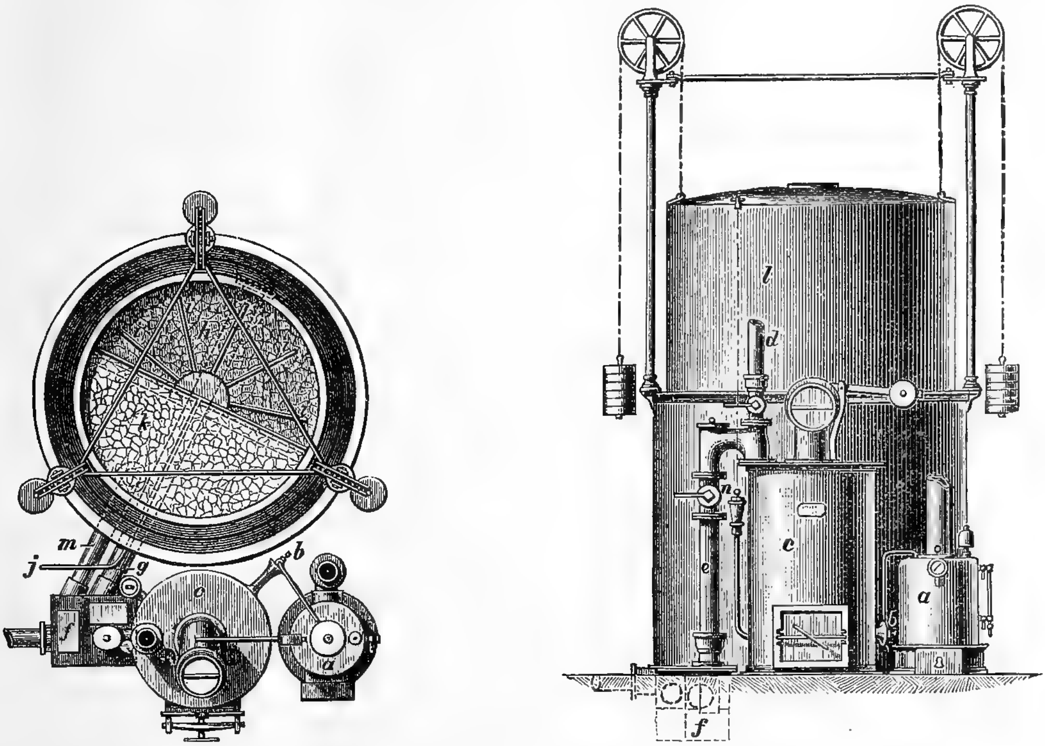
At the York meeting of the Association, in 1881, I had the privilege of explaining for the first time an apparatus with which I had succeeded in making a cheap fuel-gas, and I gave the economical results of working some gas engines with it. An abstract of my paper will be found in the Transactions of Section G. Since then I have gained a much wider experience in connection with this subject. My apparatus has been considerably improved, and the gas made in it has been much used, not only for driving engines but for heating in many industrial processes. I propose, therefore, to give a short account of the development which has taken place, and of some of the more important results obtained:

Like other generator gas, mine is made by passing steam and air through incandescent fuel, and gas so made can be taken direct from the generator and burnt in a furnace without being purified or cooled. For such work large flames are used, and it is comparatively easy to deal with them. When, however, the gas is required for a gas engine, or for small burners, the conditions are very different. The gas must be clean, or troublesome deposits will occur in the pipes and cocks, and it must pass through a gasholder to insure uniformity of pressure in the distributing pipes. It must also be cool, and this is especially the case for gas engines, as within certain limits the cooler and denser the gas, the greater is the energy in the limited volume which can enter the cylinder. It is also essential that when small jets of gas are used, as in small burners, the gas should be fairly strong and of uniform quality, or the flames will not burn steadily. To any one accustomed to the manufacture of ordinary lighting gas, these remarks may perhaps seem too elementary, but it should be remembered that generator gas is usually required in large quantity, and that to avoid large gasholders, it should be made as quickly as it can be consumed. In one case I have had to provide plant to make gas at the rate of one million cubic feet per day, or about 90,000 cubic feet per working hour, and without expensive appliances the cooling and cleaning of so large a volume of gas is not so simple as it may at first sight appear.

The original invention dealt with the generator only, but I have since found it necessary to devise a complete set of gas plant, to meet the requirements of practical work. In nearly all cases it is important that the apparatus should occupy as little room as possible, and the accompanying figs. 1 and 2 show the arrangement usually adopted. The steam boiler is small and specially made with a super-heating coil, so that dry steam enters the generator. The gas from the generator passes through water in the washer, and then through a scrubber containing coke moistened by water. The scrubber is placed inside the gasholder tank, so as to occupy as little ground space as possible. The rise and fall of the gasholder is made to regulate the supply of steam to the injector, so that to a certain extent the production of gas can be regulated automatically to suit a varying rate of consumption. In some special cases the gas is passed through oxide of iron to remove all traces of sulphuretted hydrogen, but for general purposes chemical purification is not necessary. The whole is very compact, and a plant large enough to drive an engine of 50 h.p. indicated, occupies a ground space of only 9 ft. by 10 ft. I have always taken the view, and it has been confirmed by practice in many places, that when the consumption of gas is regular there is no need for a large holder, provided the generator is well able to make gas at the maximum rate of consumption. In the case of engines, for instance, the gas plant is to the gas-engine what the boiler is to the steam-engine, and it is no more necessary to have a large reserve of gas than to have a large reserve of steam.

As regards the composition of the gas, it necessarily depends somewhat on the quality of the coal used, and on the fuel column being kept deep enough to insure a reduction of the carbonic acid. It has been analysed independently by Professor Wm. Foster and others, and, roundly speaking, the gas now made has the same composition as that made some years ago. I then thought that possibly in a large generator containing a great mass of fuel at a high temperature the percentage of hydrogen might be increased and that of the carbonic acid reduced. Trials since made have, however, shown that the average composition is much the same whether the gas be made at the rate of 1,000 c. ft. per hour in a small generator or at the rate of 15,000 c. ft. per hour in a large one. In 1881 I stated that for gas engines it was then necessary to use five volumes of the generator gas for one of ordinary lighting gas, to develop the same power. Theoretically, the comparative explosive force of the two gases is as 3·8 : 1, and it was evident that so long as practice required five to one, the weaker gas was not being used to the best advantage. Since then some important modifications have been made in the Otto engines, and I am glad to say that it is now necessary to use only four volumes of the generator gas. On this point, therefore, theory and practice are now fairly in accord. By calculation the calorific power of 100 litres of an average sample of the generator gas is 143,213 units of heat, while that of 100 litres of ordinary 16 candle-power lighting gas is 569,264 units. Tests made with a calorimeter and in other ways confirm these figures approximately.

In 1881 only one engine of $3\frac{1}{2}$ h.p. had been worked with this gas, and this showed a consumption of 1·46 lb. of coal converted into gas per indicated h.p. per hour. Since then a large number of engines have been worked with it, one indicating over 80 h.p., and many independent tests have been made. Details of these will be found in a paper of mine in the Proceedings of the Institution of Civil Engineers for last year, and on the present occasion it will be sufficient to give a few instances only. For more than four years Messrs. Crossley Brothers, the English makers of the Otto engines, have used this gas exclusively at their works for an average of about 150 h.p., and after a careful trial extending over thirty-five weeks they found that the fuel consumption averaged only 1·3 lb. per indicated h.p. per hour, including all waste, and the coal burnt in the generator every night and during Sunday (= 112 hours per week) when the fire was alight, although there was no work. At the time of this trial the construction of the generator rendered it necessary to draw the fire every two or three weeks, to remove the clinker adhering to the firebrick lining. Since then I have altered the generator, so that when the fire has once been lighted it need never be drawn; one of these generators has now



FIGS. 1 AND 2.—THE DOWSON COMPACT PLANT FOR MAKING GENERATOR GAS ON A MODERATE SCALE.

a. Steam producer and superheater; *b.* Injector; *c.* Gas generator; *d.* Chimney and waste pipe; *e.* Down pipe conveying gas to hydraulic box; *f.* Hydraulic box; *g.* Inlet pipe of gas-holder; *h.* Wet scrubber; *ii.* Water spray pipes; *j.* Water supply pipe; *k.* Dry scrubber; *l.* Gasholder; *m.* Outlet pipe of gasholder; *n.* Steam and air escape valve.

been running continuously for over a year, and Messrs. Crossley estimate that this saves about 20 tons of coal per annum. It is also worthy of note that at these large works, owing to the use of gas, there is no chimney except for the blacksmiths' shop. The returns sent me by eleven users of Otto engines working regularly in different places, and averaging each 35 h.p., also show an average fuel consumption of about 1·3 lb. per indicated h.p. per hour. Messrs. Ibotson, of the Colnbrook Paper Mills were supplied with a single cylinder Otto engine to indicate about 45 h.p. with this gas, on the guaranteed condition that the engine and gas plant could be worked continuously day and night, and that the fuel consumption should not exceed $1\frac{1}{2}$ lb. per indicated h.p. per hour. A trial was made extending over two weeks, the engine being indicated day and night at frequent intervals, and the result showed that the guarantee was in all respects fulfilled. The Otto engine makers in Germany have made exhaustive trials with this gas in connection with several of their engines, and have fully confirmed the results obtained by Messrs. Crossley in this country. Professor K. Teichmann, of the Royal Technical School of Stuttgart, and Mr. F. Böcking, Chief Engineer of the Rhenish Society for examining steam boilers, made a joint test of a twin-cylinder Otto engine worked with this gas. The engine developed a brake power of about 52 h.p., and the total fuel consumption including that used for the super-heating boiler was 1·6 lb. per *brake*, or barely 1·3 lb. per indicated h.p. per hour. Professor Witz, of Lille, a well-known scientific authority on the gas engine, has tested two Delamare-Deboutteville engines worked with this gas—one of 9 h.p., and the other of 25 h.p. effective. The first trial, of which full details were published in *Engineering*, gave a consumption of 89 c. ft. of gas, equal to 1·33 lbs. of coal per *brake* h.p. per hour. I have not exact particulars of the second trial, but I understand from the maker of the engine, Mr. Thomas Powell, of Rouen, that the result was even more favourable. Seeing that all these results have been obtained under practical working conditions, the record is certainly satisfactory, and I am pleased to add that I have also many letters testifying to the ease with which the gas-plant can be managed. This is an important point, for if the saving of fuel could only be effected in a complicated way, the apparatus could not be generally adopted. The total number of engines already made to work with this gas is 71, and the aggregate horse power is 2,390, or an average of nearly 34 horse power each.

I consider myself justified in saying that gas power is now fairly launched in competition with steam power, and to my mind there are reasonable grounds for supposing that eventually the former will to a great extent supersede the latter. In this view I am confirmed by the late Professor Fleeming Jenkin, who, in his lecture at the Institution of Civil Engineers, on "Gas and Caloric Engines," remarked—

"Since theory shows that it is possible to increase the efficiency of the actual gas engine, two—or even three—fold, then the conclusion seems irresistible that gas engines will ultimately supplant the steam engine. The steam engine has been improved nearly as far as possible, but the internal combustion gas engine can undoubtedly be greatly improved and must command a brilliant future."

It has been proved that the absolute efficiency of the gas engine—*i.e.*, the ratio between the indicated h.p. and the total quantity of heat generated by the fuel per minute—is already about double that of the best steam engine. As regards the mechanical efficiency—*i.e*, the difference between the gross indicated power developed in the cylinder, and the effective power given off on the brake—in the condensing steam-engine it is taken at about 80 per cent., and in the non-condensing engine at about 85 per cent. In the gas engine I showed, in my Inst.C.E. paper before referred to, that the average of several examples given was about 84 per cent. The Otto and other compression engines are of comparatively recent invention, and it is fair to assume that further improvements will yet be made, as the principles on which they should be based are now well understood. An important modification, for instance, has only recently been made in the Otto engine, the slide valves being entirely dispensed with.

We have seen that the results already obtained with this generator gas are good, but I cannot help feeling that still better results can and will be obtained, when the engine is really designed to give the best effect with a gas of this kind. It is well known that in the Otto engines each new charge of gas is diluted with a portion of the products of combustion from the previous charge, and, for reasons I need not now discuss, this answers very well with ordinary lighting gas. But as generator gas such as mine has only about one-fourth the explosive power of the other gas, it is a disadvantage to dilute it with products of combustion. Sooner or later this point will no doubt receive due attention, especially as the economical use of gas engines of high power must depend on their being worked with cheap gas. Looking to the probable extension of gas power, it is, in fact, most important that the best possible engine should be made for the fuel gas.

For gas engines, as now made, it is important that the generator gas should be as clean and free from sulphur compounds and ammonia as ordinary lighting gas. With this in view the best fuel to use is anthracite, as it does not yield tar or other condensable products which foul the pipes and valves. It is also suitable because it does not cake, and because it makes a dense fire, free from holes. Good qualities of anthracite yield but a small percentage of clinker and of sulphur compounds, and no ammonia. With some special precautions ordinary gas-coke can also be used. The quality of gas-coke varies, however, very much in different localities, and this is doubtless due in some measure to the different kinds of coal from which the coke is made, but also to the varying heats to which it is subjected in the retorts of different gas works. Some coke yields very large quantities of clinker, and is quite unfit for use in such an apparatus as mine. Other samples yield less clinker, but owing to the comparatively low temperature to which they have been subjected in the retorts, they retain hydro-carbonaceous bodies which vaporise in the generator, and are afterwards troublesome to remove from the gas. As before mentioned, these difficulties are not met with when the hot generator gas can be taken direct to a furnace; but when it is necessary to cool and clean the gas, as for engine work, special precautions must be taken.

Several trials have shown that when the gas apparatus is worked with anthracite the actual fuel consumption is about 13 lb. per 1,000 c.ft., including that used for producing the steam required, but to cover all sources of waste, as well as inferiority of quality, I usually allow

15 lb. per 1,000 c. ft. passed into the holder under ordinary conditions of temperature and pressure. On this basis the yield of gas is a little over 149,000 c. ft., or, allowing for the presence of 50 per cent. of nitrogen and carbonic acid, say 74,500 c. ft., of combustible gas per ton of fuel consumed.

(To be continued.)

THE ARCHÆOPTERYX.

THE oldest known bird was found in the Mesozoic (Jurassic) strata, at Solenhofen, in Bavaria. The history of its remains is curious. A single feather was first found in 1860, and caused much talk. Then, in 1861, a whole specimen came to light, and this, after much cogitation of learned geologists and naturalists, was christened *Archæopteryx macrura*, from its long tail (*archaios*, ancient; *pterux*, wing; *makros*, long; *oura*, tail). There was much competition among the varied distinguished museums as to which should have the honour of possessing the ancient specimen, and at length our British Museum carried off the prize, paying £700 for the privilege. A still more perfect specimen (of which we give an illustration) was found in 1877, at the Pappenheim Quarries; this was offered to the British Government, who were very desirous of having it, but in recollection of the previous specimen, for which they had paid £700, they refused to purchase it, and it was then sold to the German Museum, at Berlin, for about £1,000; and unscientific observers were much struck with the enormous price paid for so insignificant-looking a creature. Scientific men then concerned themselves with the position of the animal in the zoological world; and Huxley created an order all for itself, the *Saururæ* (*saura*, a lizard; *cura*, tail), for no other bird was found which could be classed with it. From the remains of the specimen, now in the Natural History Museum, South Kensington, it seemed evident

THE ARCHÆOPTERYX. (AFTER DAMES.)

that the body could not have been all covered with feathers, but must have had a smooth skin; this was gathered from the accurate impression left by the wing and tail feathers, while no impression was left of feathers elsewhere, except a circlet surrounding the neck, like that of the Condor. The size was about that of a rook, but its structure seemed half to resemble a bird, half a reptile. The presence of feathers, which denote hot blood, and the anchylosed metatarsals proclaimed it a bird, but the reptilian characters, which have now disappeared in process of evolution in modern birds, were decidedly present in three forms.

(1) True teeth, which can be easily distinguished in our illustration, were embedded in distinct sockets.

(2) It possessed a lizard-like tail.

(3) The hand resembled that of a lizard, though the phalanges of the digits in number agreed with birds. Taking the various parts of its body into consideration, it became regarded as an example of the now known fact that there can really be no definite line drawn in the animal kingdom, and that things seem to glide into one another from the simplest forms to the highest structures.

Some dispute and discussion on the point, however, arose, and Dr. W. Dames, a German man of science, published in 1884 a monograph on the subject, in which he maintained that the archæopteryx was by no means an animal occupying an intermediate position between birds and reptiles, but that it was a distinct bird of the Carinate class; and that in the latest-found specimen examined by him a well-preserved coating of feathers covering the body was noticeable.

It is not improbable that birds may have existed long before the time indicated by the records discovered, and we should be cautious in not inferring their non-existence in strata because we find no actual proof of their presence. For, as Sir Charles Lyell says, "The powers of flight possessed by most birds would insure them against perishing by numerous casualties to which quadrupeds are exposed during floods," and "if they chance to be drowned, or to die when swimming on water, it will scarcely ever happen that they will be submerged so as to become preserved in sedimentary deposits," the hollowness and lightness of their bones would cause them to float a considerable time; probably bones and all would become the food of hungry animals.

In the valley of the Connecticut river, in the United States, are, however, certain footprints which have been thought to be the impressions of birds. The strata in which they have been found are Triassic sandstones, and if the traces are really those of birds, then their ancestry can be traced to the beginning of Mesozoic times, or even into Palæozoic ages; but some think them to be impressions left by Deinosaurian reptiles which have hopped about on two hind legs. On this point geologists are divided in opinion.

DURABLE BOOKBINDING.

ABOUT a year ago (Scientific News, vol. i., p. 85) we called attention to the causes of decay in leather-bound books, and offered hints as to likely remedies. It may be of use to those who have suffered in this way if we quote the specification and estimate adopted by the Library of the Yorkshire College, Leeds. The specification aims at securing such permanence as can be given by the best materials and the most approved methods of binding. It has been in use for three years, and though this is too short a term to justify a very confident opinion, all the indications favour the belief that the books so bound will prove really durable. It will be seen that no leather except the best morocco is used at all. The choice of leather or cloth is determined mainly by the amount of wear to which the book is subject. By comparison with a number of binders' accounts, it appears that the prices here given would not have been considered unreasonable for ordinary binding in cloth or half-calf, with no stipulation as to materials or workmanship.

Specification for Bookbinding.

Collation.—Each book to be carefully examined, and notice of any imperfections to be sent to the Librarian.

Sewing.—The books to be sewn single-sheet-on, *i.e.*, each section to be sewn the full length, and on best quality of broad tape.

Forwarding.—Each back to consist of two boards glued together, the tapes being placed between the two boards and firmly pressed. Fast backs, raised bands, silk head-bands, edges washed with colour, and burnished.

Finishing.—No paste-washing to be used in finishing the books. Books to be lettered with author's name, short title, and date, gold fillet on the raised bands, blind fillet on each side of band, and on sides. End-papers not to be fastened down.

Plates.—Double plates to be mounted on guards.

Cloth Joints.—Folios and quartos to have cloth joints.

Materials.—The boards to be of best Buckinghamshire millboard. The cloth to be Winterbottom's first quality, of approved colour and pattern. The leather to best morocco, dyed with natural dyes, and supplied by Messrs. J. J. Flitch and Son, Leeds.

Estimate.

	Full Cloth.	Half-Morocco.
Crown 8vo	1s. 6d.	2s. 9d.
Demy 8vo	1s. 10d.	3s. 2d.
Royal 8vo	2s. 2d.	3s. 9d.
Imperial 8vo	2s. 6d.	4s. 3d.
Crown 4to	2s. 9d.	4s. 9d.
Demy 4to	3s.	5s. 2d.
Royal 4to	3s. 4d.	5s. 8d.
Imperial 4to	4s.	6s.
Crown folio	4s. 4d.	6s. 6d.
Demy folio	4s. 9d.	7s. 3d.
Royal folio	5s. 2d.	7s. 9d.
Imperial folio	5s. 6d.	8s. 6d.

The Electric Light in Fishing.—Recent experiments have been made on the Welsh coast to determine the application of the electric light to fishing in the night. The nets were let down to the depth of three fathoms; the one furnished with an Edison-Swan glow-lamp, and the other in the ordinary conditions. The first when raised was found full of fish, whilst the second was empty. At the depth of six fathoms the same result was obtained. In another experiment the nets were both illuminated, but the one was let down to the depth of five fathoms and the other was placed at the surface. Both contained a large quantity of fish, but those caught at the depth of five fathoms were not the same as those obtained from the surface.

General Notes.

The Centenary of the University of Montpellier.—This will be celebrated in 1889-1890 with all due solemnity.

Culture of the Vine in Australia.—*Cosmos* looks with alarm on the increase of vineyards in Australia, the profits of which are considerable enough to occasion disquiet to the French vine-growers.

Mechanical Theory of Lightning.—M. Charles Moussette (*Comptes Rendus*) is of opinion that lightning is a projectile, the luminous track described being merely the trajectory of a globular " thunderbolt."

A Physiological Laboratory for Bombay.—According to the *Medical Press*, the University of Bombay is still sadly in need of a physiological laboratory, an essential element in imparting a thorough medical education.

The Meteorite of Bahia.—This enormous meteorite, described by Mornay and Wollaston in 1816, and estimated to weigh between six and nine tons, has lately been conveyed to Rio, and safely lodged in the National Museum.

The Electric Treatment of Disease. — Among electricians in America it is currently asserted that workmen engaged among the machines for the production and the distribution of the electric light are found singularly free from rheumatism and neuralgia.

Supposed Submarine Earthquake in the Baltic.—In the morning of August 17th, the inhabitants of Rûgen saw two enormous waves approaching from the north-west which broke on the shore, doing considerable damage to the vessels at anchor. The sea was otherwise calm, and there was no wind.

A Canal across Jutland.—According to *Cosmos*, the Danish Government has just granted a concession for a canal which will intersect the north part of Jutland. It will leave the North Sea in the Jammer Bay. The new canal will save ships from having to double the north point of Jutland, Cape Skagen—a true cape of tempests.

The Climate of Assab.—According to a medical contemporary, Assab, at the southern extremity of the Red Sea, has the honour of being the hottest place in the world, its mean temperature exceeding that of Aden by 3°. For four successive months the thermometer at 9 a.m. stood above 90° F. in the shade, and rarely fell below 88° F.

The Rainfall of the Season.—Contrary to the popular impression, the rainfall for the year 1888 is, so far, not in excess of the average, and, in certain parts of Britain, falls even below it. The unsatisfactory character of the summer is due, not to the weight of rain, but to the deficiency of sunshine, the low temperature, and the excess of wind.

A Low Death-Rate.—The mortality in the townships of Barton and Monton, a few miles to the west of Manchester, has been only a little above five in the thousand, whilst in Manchester it has exceeded twenty-six. As there is no perceptible difference in the climate, the high death-rate of Manchester must be due to human neglect or error, and must be capable of reduction.

Centenarianism.—*La Nature* records the death, at Muro, in Corsica, of a man aged 113 years three months. Antonio Giovani Marchetti was born at Zilia, on May 1st, 1775. He became a soldier in 1793, and served under the first Napoleon from the siege of Toulon to Marengo, where he was very severely wounded. He settled afterwards at Muro, and was married four times.

Production of Milk in the United States.—According to the *Journal de l'Agriculture*, there are in the United States 21 millions of milking cows, and their total yearly yield of milk is 294 million hectolitres. Two-thirds of the produce is converted into butter and cheese. The value of this production exceeds that of the wheat grown in the United States, and nearly equals that of the maize.

Botanical Statistics.—According to Mr. J. G. Baker, F.R.S. (*Midland Naturalist*), before the war of secession in the United States, the Southern States had almost a monopoly of the trade in raw cotton. Last year the value of the raw cotton exported from India was between fourteen and fifteen million pounds sterling. In 1840 China had a monopoly of the tea trade. In 1883-4 the value of the tea imported from India was over four million pounds sterling.

A Variable Star (?)—Professor H. Fol reports having seen from the balcony of the Grand Hotel at Toulon, on August 24th last, a little before 9 p.m., a star more brilliant than those of the first magnitude and having a very red lustre. It was in the upper part of the constellation Virgo and at the same height above the horizon as Antares. It had no apparent movement, and seemingly no diameter. The observer after watching for some minutes went in to fetch a map of the stars, but on his return it had disappeared.

Photographing the Heavens.—After fifteen months' delay, the Treasury have at last sanctioned the provision of two telescopes to enable Greenwich and the Cape of Good Hope observatories to take their share in the international scheme for charting the heavens by photography. There will now be five British and colonial observatories taking part in the work, as instruments were ordered some months back for Oxford University, Sydney, and Melbourne observatories; but their construction has been delayed by the tardiness of our Government in arriving at a decision.

Ruins of an Ancient City in Russia.—It is announced that on the right bank of the Volga there exist the ruins of a large city extending over a space of nearly two miles in length, by rather more than half a mile in width. A deputation from the Commission of Archives has recently visited the localities, when there were found a great quantity of Arabian, Persian, and Tartar coins and medals, among a crowd of objects of various kinds indicating a very advanced civilisation as prevalent among the ancient inhabitants. Numerous blocks of marble and ruins of waterworks enable the plan of the ancient city to be to some extent ascertained.

The Hydrophone.—Commandant Banaré has devised an apparatus in place of the syren, and has named it the hydrophone. It is well known that in foggy weather ships make use of a deep whistling sound, produced by a syren, to prevent collisions. This whistle is heard very well at considerable distances, if the wind be not contrary, but it is often insufficient. M. Banare collects on one ship, by means of a special microphone, the sound-waves transmitted by the water, and emanating from a vibrating body placed on board of another ship. Experiments have been made at Brest between two ships, one of which was at anchor, and then between two vessels, both in motion. In the former series the noise of the screw of the moving ship was heard plainly. In both series the success was decisive.

Two Eclipses of the Moon Observed at Babylon.—M. Oppert communicated recently to the Academy of Sciences the translation of a cuneiform inscription narrating two eclipses of the moon observed at Babylon in the year 168, of an unknown local era and in the year 232, of the era of Arsaces, corresponding to the year 256 B.C. The inscription describes the two phenomena with every detail. Two phrases relating to the planets Mercury and Venus could not be deciphered. If we compare the eclipse of the year 232 with one of the ancient eclipses calculated by Professor Oppolzer, we find that all the particulars related by the inscription are verified. According to M. Faye, observations of this kind are important for improving the theory of the movement of the moon.

The Effects of Coal-smoke.—The injurious action of coal-smoke upon vegetation seems to be the joint effect of two factors which have not been separately estimated. On the one hand there is the visible, opaque matter, consisting of particles of carbon, which acts by obstructing the pores of plants and by diminishing the total intensity of the sunshine. This factor can be reduced by what is commonly called "smoke-consumption." On the other hand, we have the transparent, invisible sulphurous acid gas, which blights all vegetation. Against this part of the mischief smoke-consumption is powerless. The only hope lies in minimising the quantity of fuel burnt. This may be effected in manufacturing establishments by obtaining the full duty out of every pound of coal, and in households by the sacrifice of the open fire, which wastes at the very least seven-eighths of the heat generated.

Chinese Cookery.—The *Journal d'Hygiène* reports that a missionary during his stay in China had often seen the pupæ of the silkworm used as an article of diet. He has personally tried this dish, and finds it savoury and nutritious, and well adapted for invalids.

After having reeled off the silk the larvæ are stoved to free them from moisture. The outer coating is easily removed, and there are then seen small yellow masses resembling the *ova* of the carp. They are then fried in butter, lard, or oil, and seasoned with chicken-broth. When the whole has boiled for four or five minutes, it is bruised with a wooden spoon, and kept well stirred to prevent it from adhering to the bottom of the pan.

The mandarins, and in general the wealthy, add yolk of egg in the proportion of 1 to 100 pupæ. This addition causes it to exhale an exquisite odour, and to take the colour of cream. The poor merely add salt, pepper, and vinegar.

Earthquake in Iceland.—Captain Brown, of the Icelandic trading steamer Princess Alexandra, of Glasgow, brings intelligence of a reported earthquake or volcanic eruption in Iceland. Shortly after leaving Reykjavik on the afternoon of August 24th, the steamer got into a thick sulphurous atmosphere, which continued for three hours, the distance run during the time being thirty miles. After emerging out of this atmosphere, which was very stifling, the steamer got into very disturbed water, and the compasses on board became unsteady, moving from point to point. The steamer then encountered a strong east-north east wind, with a clear atmosphere, and her course was altered to a southerly direction in order to get clear away from the effects of the volcanic disturbance. This course was kept for seventy miles, when the steamer got into smoother water. Captain Brown is of opinion that the disturbance of the sea, which resembled the waters of the Pentland Firth during a storm, was caused by an earthquake, which had extended its influence seaward for thirty miles.

The Public Health.—The Registrar-General's return for the week ending September 8th shows that the deaths registered during that period in twenty-eight great towns of England and Wales corresponded to an annual rate of 17 8 per 1,000 of their aggregate population, which is estimated at 9,398,273 persons in the middle of this year. The six healthiest places were Bristol, Brighton, Portsmouth, Nottingham, Wolverhampton, and Sunderland. In London 2,475 births and 1,316 deaths were registered. Allowances made for increase of population, the births were 264, and the deaths 130, below the average numbers in the corresponding weeks of the last ten years. The annual death-rate per 1,000 from all causes, which had been 17·5 and 16 4 in the two preceding weeks, further declined last week to 16·0. During the first ten weeks of the current quarter the death-rate averaged 16·2 per 1,000, and was 4·1 below the mean rate in the corresponding periods of the ten years 1878-87. The 1,316 deaths included 26 from measles, 19 from scarlet fever, 18 from diphtheria, 32 from whooping cough, 11 from enteric fever, one from an undefined form of continued fever, 131 from diarrhœa and dysentery, three from cholera and choleraic diarrhœa, and not one from small-pox or typhus; thus 241 deaths were referred to these diseases, being 43 below the corrected average weekly number. The death of a journeyman tailor, formerly of Whitechapel, whose age was stated to be 103 years, occurred on the 4th inst, in the Hand-in-Hand Asylum at Hackney. In Greater London 3,249 births and 1,630 deaths were registered, corresponding to annual rates of 30·7 and 15·4 per 1,000 of the estimated population. In the Outer Ring 33 deaths from diarrhœa, seven from measles, six from scarlet fever, and five from whooping-cough were registered. Of the fatal cases of diarrhœa, six occurred in Stratford, four in Tottenham, three in Bromley, three in Willesden, and three in Leyton sub-districts. The deaths from measles included three in Tottenham and two in West Ham sub-districts; and four of the six fatal cases of scarlet fever occurred in West Ham sub-district.

SURFACE TENSION.

We here lay before our readers the abstract of a paper read before the Microscopical Society of Belgium, as reported in *La Nature*, from which source we also borrow the accompanying illustrations.

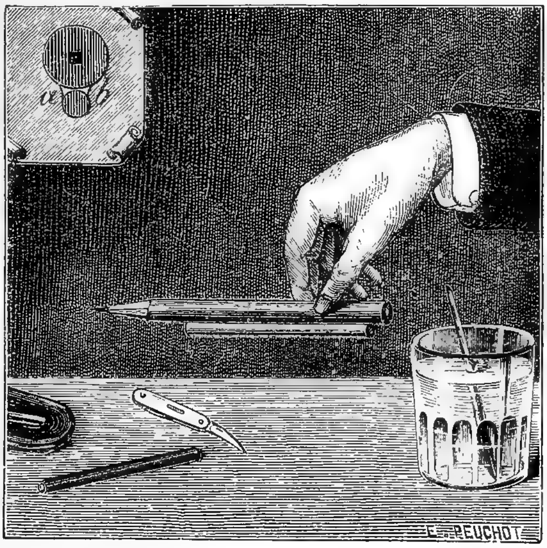


Fig. 1.

Let us consider a glass containing water; is the liquid everywhere constituted alike? This has been believed or a long time, but the belief is being abandoned. To form a clear idea on this subject, let us examine the forces which act upon the particles. In the first place,

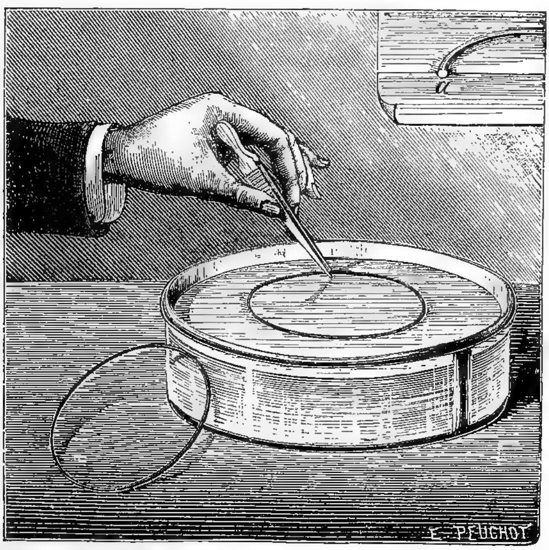


Fig. 2.

there is attractive force; for if we plunge a pencil into the water, and then withdraw it, there will be a drop hanging to the pencil. If we imagine a horizontal plane dividing the drop, all the particles situate above such plane must be regarded as sustained by those which are above, without which there can be no equilibrium. This cohesion is evidently due to attractive forces. On the other hand, there are repulsive forces which tend to sever the particles. If we leave the glass of water to itself, the liquid will ultimately entirely evaporate. Is not this a proof that if there be forces tend-

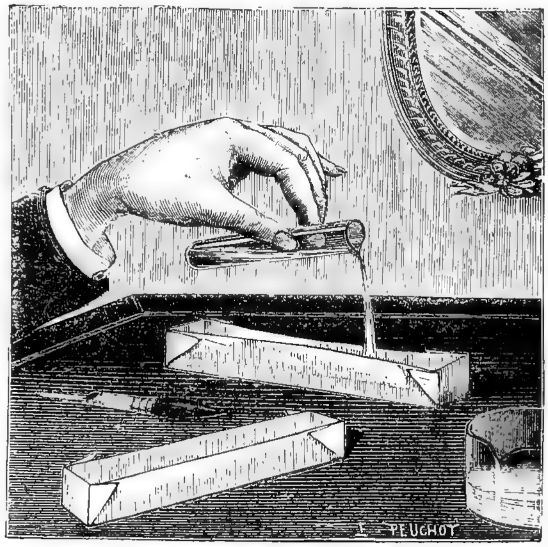


Fig. 3.

ing to approximate the particles of liquid to each other, there are others in virtue of which these particles diverge from each other?

On studying the constitution of liquids from this point of view we have arrived at the following result: an

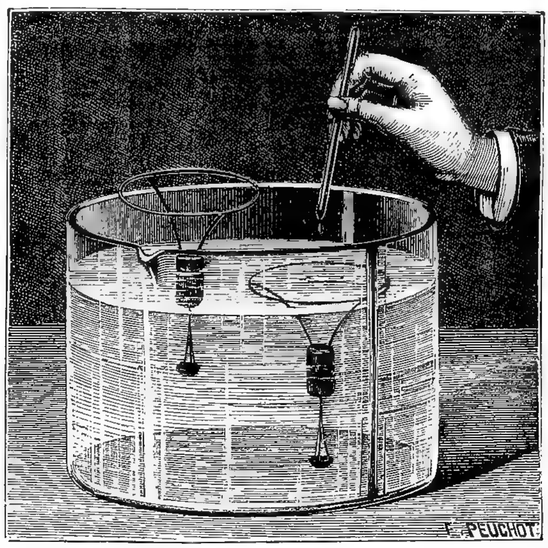


Fig. 4.

equilibrium cannot exist in a liquid between the attractive and repulsive forces, unless there is, in the immediate proximity to the free surface, a tendency to the mutual separation of particles, combated incessantly by the attractive forces.

But is not this state of the superficial layer comparable to that of a thin elastic membrane which we stretch by exerting a certain effort, whilst its cohesion is at each moment opposed to any further extension? This is why we may say that the free superficial stratum of a liquid is submitted to a contractile force or tension in virtue of which it possesses a tendency to become as small as possible.

But what is the thickness of the stratum which is the seat of this tendency? Plateau and Quinete have found by different methods that the thickness of this superficial stratum does not exceed $\frac{1}{20000}$ of a millimetre in thickness. And what is the intensity of the contractile force? It varies from one liquid to another, and in one and the same liquid it generally decreases as the temperature rises. At 59° Fahr. the tension of distilled water is about 7·5 milligrams per millimetre of length; olive oil has, under the same conditions, a tension of 3·6, petroleum of 2·6, absolute alcohol of 2·5, and ether of 1·88 milligrams.

But we must now demonstrate the existence of the contractile force by some very simple experiments.

First Experiment.—Let us take two pencils, one of which must be of very light wood and not more than three or four millimetres in thickness. We apply them to each other, so that they may touch in a horizontal straight line. In the space close to this line of contact we put a few drops of pure common water, so that the parts bordering on the line of contact may be well wetted. There will then be formed, adhering to the two pencils, a small liquid mass, of a concave curvature, which is shown in section in fig. 1, *a b*. Then the pencil of light wood can remain suspended to the other, by reason of the tension of the concave surfaces *a b* which prevail on either hand of the line of contact. For instance, if the length of the pencils is twelve centimetres, the weight which can be sustained will be $2 \times 120 \times 7{\cdot}5 = 1800$ milligrammes. The lighter pencil must therefore weigh less than 1·8 gramme.

Second Experiment.—We cleanse perfectly a ring of copper wire of about one millimetre in thickness and eight centimetres in diameter, and place it with care upon the surface of pure water in a capsule which has previously been well washed. The copper ring will float (fig. 2, section *a*), and this though its density is 8·8 times greater than that of water. This is because all the tensions of the liquid which prevail on the one hand and the other of the ring give a resultant acting from below upwards. A very simple calculation shows that the weight of the ring is about $\pi \times (\frac{1}{2}) \times \pi \times 80 \times 8{\cdot}8$ milligrammes $= 1{\cdot}73$ grammes. On the other hand, the maximum effect of the tensions is $2 \times \pi \times 80 \times 8{\cdot}5$ milligrammes $= 3{\cdot}77$ grammes. We see, then, that even if we disregard the thrust of the liquid, the effect of the surface tension is more than double the weight of the ring.

In the same manner we may float upon water needles, globules of mercury, a slender platinum ring, etc.

Third Experiment.—We procure a leaf of light unglazed paper (*e.g.*, silk-paper), say seventeen centimetres in length and three in width. All the edges are folded (fig. 3) so as to form a rectangle of fifteen centimetres in length and one centimetre in breadth; all the edges are turned up to the height of one centimetre, and four small folds are made following a diagonal of each of the squares formed by the first folds, and we thus obtain a small box, the long sides of which are made very flat. This being done, the apparatus is set upon a table; all the inner surfaces are well moistened by means of a brush, and water is poured in to the height of 4—5 millimetres. Immediately, the tension of the liquid surface draws together the long sides which are opposite to each other, and the vessel becomes closed automatically.

Fourth Experiment.—Take a cylindrical cork (fig. 4) of, *e.g.*, two centimetres in thickness and four in length; in the centre of one of the ends we insert a very fine iron wire, six or eight centimetres in length, and having at its lower end a hook or a small basket suitable for receiving a load. To the opposite end of the cork is fixed a system composed of a ring of fine wire ten centimetres in diameter, and supported by two ends of the same wire which are inserted into the cork in such a manner that the plane of the ring may be perpendicular to the axis of the latter and placed concentrically with respect to it.

This being done, the small apparatus is plunged into water contained in a vessel of sufficient depth; if the load be suitable, the cork will remain upright, and will only project eight or ten millimetres above the level (fig. 4). If the entire system be made to descend vertically into the water and be left to itself, the ring will not again leave the water; it will merely rise a little above the level, producing a bi-concave meniscus. Here the result of the surface tension gives rise to a resultant acting from above downwards and sufficient to counterbalance the increase of the thrust. If the load be suitable, this resultant, augmented by the weight of the system, very little exceeds the upward thrust of the liquid. It is then sufficient to bring near the water a little wadding soaked in ether (which decreases the surface tension) to see the ring, in appearance, spontaneously rise out of the liquid and the system resume its original position of equilibrium.

(*To be continued.*)

PAPER BOTTLES.

ONE of the most interesting of the many uses to which paper has been put is the manufacture of paper bottles.

We have long had paper boxes, barrels, and car wheels, and more recently paper pails, wash basins, and other vessels; but now comes a further evolution of paper in the shape of paper bottles, which are already quite extensively used for containing such substances as ink, bluing, shoe dressing, glue, etc., and they would seem to be equally well adapted for containing a large variety of articles.

They are made by rolling glued sheets of paper into long cylinders, which are then cut into suitable lengths, tops and bottoms are fitted in the inside coated with a waterproof compound, and all this is done by machinery almost as quickly as one can count.

They are cheaper and lighter than glass, unbreakable, and consequently very popular with consumers, while the fact that they require no packing material, and are clean, handy, and economical, commends them to manufacturers. Unlike glass, they can be manufactured and shipped at all seasons; and being made by machinery, the supply is independent of labour troubles, which are additional advantages to manufacturers who use bottles.

FUNCTION OF THE HALTERES OR BALANCERS IN DIPTEROUS INSECTS.—It is contended that in the common fly and in its congeners these parts contain the organs of hearing.

Natural History.

THE KAGU.

THE Kagu, a small bird by no means as imposing as its dignified appellation, *Rhinocetus jubatus*, has given rise to some discussion as to its true position in ornithological classification. Professor Parker, F.R.S., published a long paper on its osteological formation, in the Transactions of the Zoological Society, in which he asserted that it constituted a type of a distinct family belonging to Professor Huxley's order, *Geranomorphæ*, closely allied to the *Psophia* (trumpeters) and *Eurypygae* (bitterns). A writer in the "Standard Natural History" makes it the type of an entire family, *Rhinocetidae*, but Mr. Bartlett, Superintendent of the Zoological Gardens, agreed with Professor Parker in ranking it with the sun bittern (*Eurypyga helias*), whence he allied it again to the herons, cranes, rails, and plovers, an opinion which is, we believe, now universally accepted.

The Kagu (to call it by its native name) was first described by some French naturalists, about the middle of the present century, in a memoir on the Ornithology of New Caledonia, an island in the South Pacific, east of Australia, which had then been recently colonised by the French. In December, 1861, Dr. George Bennett, of Sydney, New South Wales, received a present of a living Kagu from his friend, M. D. H. Joubert, one of the settlers in New Caledonia, who had had it in his possession for a short time. This bird, together with another which was subsequently presented to him, Dr. Bennett forwarded to the Zoological Society in London, where they arrived safe and well on the 22nd of April, 1862, the first specimens of their kind to reach this country alive. At that time the Kagus were very numerous in New Caledonia, and Mr. Ferdinand

Joubert, son of the above-mentioned gentleman, writing from Kai, in the interior of the island, remarked that these birds were particularly plentiful in all the neighbourhood of Kai and in the district of the Boh Mountains. Unfortunately, however, they were discovered to be excellent for the table, and were forthwith snared and shot in great quantities by both natives and settlers, with the natural result that some twenty years later their numbers had decreased to such an extent that they were only to be found in certain parts of the country, and are now so scarce that when a gentleman leaving Port de France, N. C., offered a large reward for a live Kagu to take back to France with him, not a single bird was to be found for miles around. The natives were in the habit of catching the Kagus by means of a strong string fastened to the ground with a loose slip knot, in which the birds would become hopelessly entangled, thus falling an easy prey to their captors.

M. Ferdinand Joubert called attention to the fact that there were two distinct kinds of this bird, one the "Bush Kagu," as he termed it, large and handsome and comparatively serene in disposition; the other, the "Grass Kagu," much smaller and darker, with dark stripes on its wings and tail, and so pugnacious that fights were of constant occurrence, despite the fact that the aggressive little "Grass Kagu" was invariably ignominiously defeated.

Dr. Bennett describes this bird as about the size of an ordinary fowl. The female is usually slightly the larger of the two, and rather more graceful in shape, with pale brown plumage, and with bill, feet, and legs of a pale orange colour. The plumage of the male bird is dark brown, with bars of a paler shade, the primaries and secondaries of the wings very dark brown, barred with black, the long pending crest on the nape of the head dark grey, the bill and legs vivid orange scarlet, and the iris orange. The voices of both birds are peculiar; the female utters a strange kind of growling scream, and the male a noise which is an extraordinary compound between a bark and a laugh, and which sometimes in their wild state is said to sound like a young puppy calling for its mother. Like most birds of the heron tribe, the *Rhinocetus jubatus* has the remarkable powder-down tufts, characteristic of the Ardeines, strongly developed, having the down tufts above and around its wings, and on its breast and back, thickly stored with powder. Mr. Bartlett remarked that when these birds bathed, the whole surface of the little pond was immediately covered with a sort of film, somewhat resembling French chalk. The markings of the Kagu's wing and tail feathers strongly resemble those of the sun-bittern, and although no eggs have hitherto been found in its native home, the one "obligingly" laid by the specimen in the Zoological Gardens (the adverb is Professor Parker's) bears a great similarity in both form and colour to that of the bittern, and is further proof of the relation of the two birds. The Kagu possesses a distinctive feature in the peculiar scroll-like membrane which surrounds the nostrils, which, closing entirely over the aperture when the beak is inserted into the soft earth and mud where the bird seeks its food, effectually prevents the entrance of any extraneous matter into the nostril. The female bird has a curious habit of crouching on the ground and covering herself with her wings, throwing them up in concave form over her back, so as to completely hide her head and body.

(*To be continued.*)

The Language of Crows.—According to Dr. C. C. Abbott, a well-known and trustworthy observer of bird-life, crows have twenty-seven distinct cries, calls, and utterances, each readily distinguishable from the others, and each having an unmistakable connection with a certain class of actions. Is it not fully time that the cant expression "dumb animals," peculiar as it is to England, should cease to be employed?

Vital Conditions of Bacteria.—A writer in the *Berichte der Deutschen Chemischen Gesellschaft* finds that air, and still more pure oxygen, promotes the multiplication both of the bacilli of anthrax and those of putrefaction. Ozone, however, is fatal to the latter, though it has no power over the former.

Structure and Function.—Some time back Mr. Waterhouse, of the British Museum, exhibited at a meeting of the Entomological Society some aquatic *Curculios* which swim with the same action and the same ease as a *Dytiscus*, though their legs display no structural adaptation to the purpose.

A Wasp at Dinner.—Mr. J. H. Emerton (*Cosmos*), whilst passing through a marsh covered with alders, observed the curious spectacle of a wasp hanging from a branch by one of its hind feet, and in this strange position tranquilly devouring a fly. The prey was held by its two anterior feet, whilst the other feet and the wings were disengaged. The rapid movement of the jaws and the antennæ whilst the fly was being turned to and fro caused the body of the wasp to keep gently swinging. When nothing remained of the fly beyond the wings and the shell the wasp let fall the remnants, drew herself up on the branch and took wing in quest of fresh adventures.

Experiment on the Treatment of the Potato Disease.—M. Prillieux (Paris Academy of Sciences) has treated a plot of early potatoes in which the disease had already shown itself in the form of black spots on the leaves, with "Bordeaux broth," a decoction of six parts of sulphate of copper and six parts of lime in 100 parts of water. The liquid was applied in the state of a fine dew by means of a "pulveriser." When the crop came to be gathered not one diseased tuber was found on the plants which had been treated. Adjacent plants of the same kind, but not treated, yielded 32 per cent. of diseased tubers.

Leafing of the Oak and the Ash.—Mr. J. Saunders, writing in the *Midland Naturalist*, informs us that this year a large number of trees were carefully observed in South Bedfordshire and North Hertfordshire, especially where they were growing in company, and in the great majority of cases oaks were before the ashes, the exceptions being about 10 per cent. He also considers that oak trees, upon the whole, leaf before the ash, and remarks that this season, in which the oaks have been less in advance than usual, has turned out exceptionally wet. We may here remark that there are contradictory versions of the old proverb concerning the leafing of these two trees. In some parts we are told:—

"If the oak's before the ash,
There will be nought but drip and splash;
If the ash is before the oak,
There will be nought but dust and smoke."

CUSTOMS OF SAVAGE RACES.

LECTURE DELIVERED BY SIR JOHN LUBBOCK, M.P., F.R.S., TO THE WORKING-CLASSES OF BATH.

(*Continued from p.* 304.)

CARVER astonished the Canadian Indians by allowing them to open a book wherever they pleased, and then telling them how many pages they were from the beginning. The only way they could account for this was by concluding that the book was alive, and told him whatever he asked. This belief in the mysterious character of writing has led to its being used in various parts of the world as a medicine. The Central Africans are a religious people according to their light, and have great faith in the efficacy of prayer. When anyone is ill they write a text out of the Koran on a board, wash it off, and drink it. In India charms are used in the same way, but now strong medicine is often openly put into the ink, a curious combination of medicine and superstition. It was soon observed that these charms were no protection from firearms, but that did not in the least weaken the faith in them, because the Mahomedan priest explained that as guns were not invented in Mahomet's time, he naturally provided no specific against them.

Another curious idea very prevalent among savages is their dread of having their portraits taken. The better the likeness, the worse they think for the sitter; so much life could not be put into the copy except at the expense of the original. Once, when a good deal annoyed by some Indians, Kane got rid of them instantly by threatening to draw them if they remained. Catlin tells an amusing but melancholy anecdote in illustration of this feeling among the same people. On one occasion he was making a likeness of a chief named Mahtocheega in profile. This, when observed, excited much commotion among the Indians. "Why was half his face left out?" they asked, "Mahtocheega was never afraid to look a white man in the face." Mahtocheega himself does not seem to have taken any offence, but Shonka, a hostile chief, took occasion to taunt him. "The Englishman," he said, "knows that you are but half a man; he has painted but one half of your face, and knows that the rest is good for nothing." This taunt led to a fight in which poor Mahtocheega was killed, and the whole affair was very unfortunate for Mr. Catlin, who had much difficulty in making his escape, and lived some time in fear of his life; nor was the matter ended until both Shonka and his brother had been killed in revenge for the death of Mahtocheega.

Those who have not devoted much attention to the subject have generally regarded the savage as having at least one advantage over civilised man—that, namely, of enjoying an amount of personal freedom greater than that of individuals belonging to more civilised communities. There cannot be a greater mistake. The savage is nowhere free. All over the world his daily life is regulated by a complicated set of rules, and customs as forcible as laws, of quaint prohibitions, and unjust privileges—the prohibitions generally applying to the women and the privileges to men. "The Australians," says Mr. Lang, "instead of enjoying perfect personal freedom, as it would at first appear, are governed by a code of rules and a set of customs which form one of the most cruel tyrannies that has ever perhaps existed on the face of the earth, subjecting not only the will but the property and life of the weak to the dominion of the strong. The whole tendency of the system is to give everything to the strong and old, to the prejudice of the weak and young, and more particularly to the detriment of the women. Moreover, if savages pass unnoticed many actions which we deem highly criminal, on the other hand they strictly forbid others which we regard as altogether immaterial. Thus the Mongols of Siberia think it wrong to touch fire with a knife; to use one for taking meat out of a pot; to cut up wood near a hearth; to lean on a whip; to pour liquor on the ground; to strike a horse with the bridle; to break one bone against another. The legal forms among savages are very long and tedious. But little consideration is required to show that this is quite natural. In the absence of writing, evidence of contracts must depend on the testimony of witnesses, and it is necessary therefore to avoid all haste which might lead to forgetfulness, and to imprint the ceremony as much as possible on the minds of those present.

Among the lower races of men, the chiefs scarcely take any cognisance of crime. As regards private injuries, everyone protects or revenges himself. Thus amongst the North American Indians even in cases of murder, the family of the deceased only punish the aggressor if they can. The chiefs and rulers do not feel called on to interfere. Since then crimes were at first regarded as mere personal matters, in which the aggressor and his victim alone were interested, every crime, even murder, might be atoned for by the payment of a sum of money.

Among the Anglo-Saxons every part of the body had a recognised value. Thus the loss of a front tooth was valued at six shillings, that of a beard was reckoned at twenty shillings, while the breaking of a thigh was only put at twelve, and of a rib at three, facts which show both the high value of money and also the importance attached by our ancestors to their personal appearance. Moreover these payments had reference to the injury done, and had no relation to the crime as a crime.

The religious condition of the lower races of men is one of the most interesting, but at the same time one of the most difficult parts of the whole subject. It is most difficult, partly because it is far from easy to communicate with men of a different race on such an abstruse subject; partly because so many men have no very clear ideas of what they really believe; and partly because even amongst those nominally professing the same religion there are often in reality great differences individually, as I shall endeavour to show you is also the case with nations, acquiring gradually higher and higher, and therefore truer ideas as they rise in the scale of civilisation. Even among races well known to us it is often very difficult to state what the orthodox opinions really are; for instance, it has long been a question amongst scholars what opinions orthodox Buddhists really entertain respecting the Deity and the condition of the soul after death. Moreover, as new religious ideas come into existence, they do not destroy, but are only superinduced upon the old ones; thus the religions of the ancestors become the nursery tales of their descendants, and the old Teutonic deities of our forefathers are the giants and demons of our children.

Savages generally assume that there is no motion without life. Hence they believe in spirits not only of animals, but plants, rivers, lakes, winds, and so on. In various parts of the world white men, when first seen, were taken for ghosts. For instance, some years ago a vessel was wrecked on the north coast of Australia, and all on board were drowned except a Scotch woman, named Thomson. She was kindly received by the natives, being taken for the ghost of a woman named Giom, who had recently died; and when she was teased by the children, the men would often say, "Let her alone, poor thing; she is nothing, only a ghost." This, however, did not prevent their marrying her to a man named Boroto. We must remember that ideas of spirits entertained by savages are very different from ours. They regard them as different indeed from, but scarcely more powerful or wiser than they are themselves. For instance, the nations of the Nicobar Islands used to put up scarecrows to frighten the spirits away from their crops. Even among a race comparatively so far advanced as the Greeks, the deities were regarded as liable to be wounded or even defeated by man. Mars himself, the very god of war, is described by Homer as being wounded by Diomede.

Various theories have been suggested to account for the deification of animals. I have ventured to suggest that it may be traced to the system of family names. We have seen that families are often called after animals, the bear, the bull, and so on. This leads to the idea—or at any rate various races have the idea, in a more or less definite form, that they are related to, or descended from the animal after which they are named. In many cases they will not injure or eat their namesake. They treat it with respect, which would gradually develop into reverence and worship.

The worship of inanimate objects is more difficult to account for. But, in fact, many savages regard everything as having life; and just as when a man died he went to the other world, so if a thing were destroyed, its spirit set out on the same long journey. Chapman mentions that the bushmen thought his waggon was the mother of his cart, and Hearne tells us that in his day the North Americans never hung up nets together for fear they should be jealous of one another.

Lord Iddesleigh, in a recent address, observed that as he stood by one of the mighty rivers of Canada, he almost felt as if the rushing waves were alive; and in fact rivers and seas are so active, and as we should say even now metaphorically, show so much life that we cannot wonder at the very general belief in a spirit of the waters, which we find prevalent in the most distant parts of the world. Among the Greeks if Neptune represented perhaps a deity ruling over the seas, Okeanos at any rate was the ocean itself. The Hindoos worship the Ganges; in North America the Mohawks believed that the spirit of Saratoga lake infallibly drowned any one who spoke while boating on it. The wife of a missionary once wishing to destroy this superstition got an Indian chief to row her across, and when they were in the middle, to his great alarm, began talking loudly. However, they got across, and when they were safe on the other side she laughed at him, but he was quite unshaken in his belief, and indeed I think had the best of it after all, for he replied gravely, "Madam, the Great Spirit is merciful, and knows that a white woman cannot hold her tongue." A belief in water spirits still lingers on in parts even of our own islands.

The heavenly bodies have long excited the wonder and admiration of mankind. Still, the worship of the sun, moon, and stars does not seem to prevail among the lower races of savages—such, for instance, as the Australians—and it was again abandoned among thoughtful races, perhaps on account of the regularity of their movements. We are expressly told in the case of Peru that the Inca Huayna Capa questioned the divine nature of the sun, because it did exactly the same thing every day. Now, he ingeniously argued, "If the sun were supreme lord he would occasionally go aside from his course, or rest for his pleasure, even though he might have no necessity for doing so."

The vestal virgins have made us all familiar with the worship of fire. Their duty was to keep the same fire perpetually burning. On the other side of the Atlantic, again, we find very similar institutions. In Peru "the sacred flame was entrusted to the virgins of the sun, and if by any neglect it was suffered to go out, the event was regarded as a calamity that boded some strange disaster to the monarchy." Very similar customs indeed prevailed among many races. The name vesta is merely a form of hestia, which in Greek meant a hearth; and vesta was the personification of the domestic hearth. We must remember that among savages it is a work of much difficulty to light a fire. Lucifer matches and other appliances make it now so very easy that we are apt to forget this. But with savages, and even until quite recently, it was very different. The commonest mode of obtaining fire was by rubbing one stick against another, and if any of you would endeavour to strike a light in this way, you would appreciate the labour it involves. Hence the fire, once obtained, was most carefully cherished. Indeed, it is said that some of the Australian tribes, though they had fire, did not know how to procure it, and, if theirs went out, were compelled to borrow a light from a neighbouring tribe. Hence. naturally, under such circumstances, it was jealously guarded, then reverenced, and at last worshipped.

We know that among many races, when a man died, his wives and slaves, sometimes, also, his horse and dog, were killed and buried with him, in order that their spirits might accompany him to the other world. But the preparation for eternity did not end here. Just as the survivors killed the wife and slaves, so they also "killed" his arms and implements, his clothes and ornaments, so that their spirits also might go with their master, and he might enter the other world as a great chief should. The Red Indian, Mr. Sproat tells us, quite understands that the things themselves remain in the grave, but believes that the phantoms of the things accompany the spirit of the dead. Even among the Greeks we know that a coin was put in the mouth of the dead, in order that he might have the wherewithal to pay the ferryman Charon; and the Chinese are said to burn paper-money with the dead—a process much to be commended from a banking point of view.

The language of poetry is another source of Divine origin. Thus the classical gods appear in the Vedic poems as mere names of natural objects. Jupiter is Zeuspater—the father Zeus; and Zeus is the Sanscrit word, Dyans—the Sleig or Heavens. When the original Indo-European said that "Dyans thundered," he meant no more than we do when we say that the heavens thundered. But gradually the word Dyans became more and more personified, until at last, under the Greeks and Romans, Zeus became a living deity, the lord of Heaven, the god of Thunder, and thus an extensive mythology gradually grew out of what were at first but poetical expressions. So far I agree with my friend Professor Max Müller, but I am only disposed to do so within comparatively narrow limits; and while admitting the explanation as applicable to certain cases, cannot regard it as having any very extensive application. In many cases the religious ideas of the lower races of men have been greatly influenced by the phenomenon of sleep.

> "Some say that gleams of a remoter world
> Visit the soul in sleep—that death is slumber,
> And that its shapes the busy thoughts outnumber
> Of those who wake and live—I look on high;
> Has some unknown omnipotence unfurled
> The veil of life and death? Or do I lie
> In dream, and does the mightier world of sleep
> Spread far around and inaccessibly
> Its circles?"
>
> —*Shelley, "Mont Blanc." Lines written in the Vale of Chamouni, Part* 3.

In sleep the body lies as it were dead; but the mind is often active, and the savage dreams as we do that when his body is asleep the mind wanders away to visit absent friends and distant regions. Hence he naturally concludes that he has a spirit which can leave the body. Hence also to him dreams have an importance and reality which we can hardly appreciate. Mr. M. Thurm tells us that when he was travelling in Guiana, his head boatman one morning insisted on thrashing one of the men because he dreamt he had been impertinent to him the night before. Hence to be unexpectedly woke up is in the eyes of some of the lower races of man a real danger. In a recent work on Burmah it is stated that an English magistrate rendered himself very unpopular by waking a native official in the middle of his siesta, or mid-day sleep. The natives argued in this way. The poor man always sleeps from 12 to 2. During this time his spirit wanders away, and often only comes back just before 2. It is now 1. Who can say where the spirit is? It may be miles away. It is barbarous to wake up a man's bod when the spirit may be at a distance. The poor wife was, it is said, terribly alarmed. In other cases dream thoughts were regarded as special inspirations, as in the beautiful verses of Job:—"In dreams, in visions of the night, when deep sleep falleth upon man, in slumberings upon the bed;" "Then God openeth the ears of men, and sealeth their instruction."

Our own sovereigns are still crowned on a stone, the Lia Fail or Stone of Destiny, which is said to have been the pillow on which the patriarch Jacob slept at Bethel when he saw "the ladder set up on the earth, and the top of it reached to heaven, and behold the angels ending and descending on it." It was carried to Ire-d, then to Iona, subsequently to Scone, and brought to England by Edward I., though some Irish antiquaries maintain that the true Lia Fail is the upright stone which stands on the hill of Tara. We all remember the significance attached by Joseph's parents and brethren to his dreams; as well as the political importance of Pharaoh's dream, which Sir Samuel Baker has recently attempted to explain by supposing that the Abyssinians had dammed up the Atbara river.

Moreover, the analogy between sleep, and that last long sleep death, could hardly fail to strike the savage. In classical mythology we are told that Mars the god of death, and Somnus the god of sleep, were both children of Nox, the goddess of the night. But as the savage every morning saw his friend awake from sleep, it was not unnatural that he should imagine that they might also arise from the tomb. Moreover, in confirmation of this the spirits of his departed relations often visited him in his dreams, and hence he readily adopted the idea that we have a soul which survives, or may survive, the body.

(To be continued.)

THE ELECTRICAL TRANSMISSION OF POWER.

A Lecture Delivered by Professor Ayrton, F.R.S., etc., before the British Association, on September 8th, and Re-delivered to the Working-Classes of Bath, on September 13th, 1888.

What is power, and why should we wish to transmit it? Power has one very definite meaning in science, and several rather vague meanings in practice. We speak of a powerful athlete, the power of the law, we sing of the power of love, we say knowledge is power, and so on, using the word in several different senses. Now in spite of the fact that a general audience feels a little anxious as to what troubles may be in store for it when a lecturer begins by being painfully exact, my telling you that by power an engineer understands the rate of doing work will not, I hope, make you fear that my remarks will bristle with technicalities.

When you walk upstairs you exert power, only perhaps the one-twentieth of a horse when you go up slowly talking to other people. But when you run upstairs because you have forgotten something that you intended to bring down, then your exertions represent perhaps the one-tenth of a horse power. You only get to the top of the stairs in either case, but the breathless sensation of running fast upstairs tells you that the more quickly you go the harder you are working. A person exercises power in the engineer's sense when he exerts himself physically, and the greater the exertion the greater the power. The exercise of power by the ruling classes, however, is unfortunately not necessarily accompanied by any exertion, physical or mental.

Probably the most familiar example of exerting power at a distance, that is of transmitting power, is pulling a handle and ringing a bell in another room. I pull the handle, exerting myself slightly, and as the result the bell at the other end of the platform rings. Were not this such a very familiar operation I would call it experiment No. 1. You have doubtless all of you performed this experiment several times to-day, and what is all-important with an experiment, performed it successfully.

And yet it was not until just one hundred years ago that it dawned on people that if one person, A, wanted to attract the attention of another person, B, the place where the bell ought to sound was where B was and not where A was. Indeed, in many English villages down to the present day, the knocker principle of attracting attention is alone resorted to, without the result which you may remember happened when Mr. Pickwick was staying in Bath at lodgings in the Royal Crescent, and Mr. Dowler undertook to sit up for Mrs. Dowler, but "made up his mind that he would throw himself on the bed in the back room and *think*—not sleep, of course. . . . . Just as the clock struck three there was blown into the crescent a sedan-chair with Mrs. Dowler inside borne by one short fat chairman and one long thin one. . . . They gave one good round double knock at the street door. . . . . 'Knock again, if you please,' said Mrs. Dowler from the chair. 'Knock two or three times, if you please.' The short man stood on the step and gave four or five most startling double knocks of eight or ten knocks apiece, while the long man went into the road and looked up at the windows for a light. Nobody came. It was as silent and dark as ever." But the tall thin man, you may remember, "kept on perpetually knocking double knocks of two loud knocks each like an insane postman" till Mr. Winkle, waking up from a dream "that he was at a club where the chairman was obliged to hammer the table a good deal to preserve order," met with the catastrophe which the readers of "Pickwick" will remember.

But if some houses can still dispense with mechanical or other methods of transmitting power, even to ring bells, factories cannot. The looms, the lathes, or whatever the machinery used in the factory may be, must either be worked by hand or foot, in the old style, or it must be connected with the steam, gas, or water engine, in the new. On entering a large factory you see lines of rapidly rotating shafting, and a network of rapidly-moving belting, all employed in transmitting power. As a contrast to this, I now throw on the screen a photograph of Sir David Salomon's workshop at Tunbridge Wells, in which every machine is worked by a separate electric motor, thus saving to a great extent the loss of power that usually accompanies the mechanical transmission. In America there are 6,000 electro motors working machinery; in Great Britain hardly 100.

But it is not only in transmitting the power from the steam, gas, or water engine of a factory to the various machines working in it, that electricity can be utilised. An incredible amount of power is daily running to waste in this and other countries because many of the rapid streams of water are too far away from towns for their power to have been hitherto utilised.

The holiday tourist, when admiring the splashing water dashing over the stones, hardly realises that the money loss is as if the foam were composed of flakes of silver.

If we take a low estimate that a large well-made steam engine burns only 2 lbs. of coal per horse power per hour, the coal consumption which would be equivalent to the waste of power at Niagara would exceed 150 millions of tons per annum, which at only 5s. or 6s. per ton means some 40 million pounds sterling wasted. And descending from big things to small, the river Avon flowing through Bath, which so far from being a roaring cataract, especially in dry weather, pursues its course with only a respectable, orderly swish, still represents a certain amount of lost power. It has been estimated that from 25 to 130 horse-power runs to waste at the Bathwick Weir behind the Guildhall, depending on the season. If we take as an all-round average that the fall at this weir represents 50 horse-power, and that a steam engine producing this power burns 150 lbs. of coal per hour, it follows that with steam coal at 16s. per ton, the price at Bath, the waste at Bathwick Weir represents an income of £450 per annum, not a princely fortune, it is true, but too large to be utterly thrown away as at present.

This state of things will, I hope, however, be shortly remedied, for as you will see from the large map on the wall, it is proposed to put up 81 electric arc lamps throughout the streets of Bath, and to supply the 50 horse-power required for these lamps by the fall at the Bathwick Weir, supplementing the fall with a steam engine at dry seasons.

The next large diagram shows the use that Lord Salisbury has made of the river Lea to electrically light Hatfield House and to supply electric motive power to the various machines working on his estate. The next diagram shows the course of the Portrush electric railway, 6½ miles long, which is worked by the Bushmill Falls, situated at about one mile from the nearest point of the railway. And lastly, this working model on the table, kindly lent me by Dr. E. Hopkinson, as well as the diagram on the wall, represent the Bessbrook and Newry electric tramway, a little over three miles in length, which is also worked entirely by water power, the turbine and dynamo which convert the water power into electric power being at about three-quarters of a mile from the Bessbrook terminus.

The newspapers of last week contained a long account of the spiral electric mountain railway that has just been opened to carry people up the Burgenstock, near Lucerne, and worked by the River Aar, three miles away, so that we see that electric traction, worked by distant water power, is extending. But splendid as are these most successful uses of water power to actuate distant electro motors, it is but a stray stream here and there that has yet been utilised, and countless wealth is still being squandered in all the torrents all over the world.

The familiarity of the fact makes it none the less striking that while we obtain in a laborious way from the depths of the earth the power we employ we let run to waste every hour of our lives many, many times as much as we use.

It is also a well-established time-honoured fact that large steam engines can be worked much more economically than small ones, and that therefore if it were possible to *economically* transmit the power from a few very large steam engines to a great number of small workshops there would be a great saving of power, as well as a great saving of time from the workmen in these many small workshops having only to employ this power for various industrial purposes, instead of having to stoke, clean, repair, and generally attend to a great number of small, uneconomical steam engines.

When delivering the lecture which I had the honour to give at the meeting of the British Association at Sheffield nine years ago, I entered fully into Professor Perry's and my own views on this subject, and, therefore, I will not enlarge on them now. You can all realise the difference between the luxury of merely getting into a train instead of having to engage post horses, of being able to send a telegram instead of employing a special messenger, or being able to turn on a gas tap and apply a match when you want a light instead of having to purchase oil and a wick, and trim a lamp. Well, a general supply of power to workshops is to the manufacturer what a general supply of light or a general supply of post-office facilities is to the householder; it is all part of the steady advance of civilisation that leads the man to go to the tailor, the shoemaker, the baker, the butcher, instead of manufacturing his own mocassins, and lassoing a buffalo for dinner. And in case any of you may be inclined to think that we have gone far enough in these new-fangled notions, and we are all perhaps prone to fall into this mistake as we grow older, let me remind you that, while each age regards with unjustifiable pride the superiority of its ways to those of its ancestors, that very age will appear but semi-civilised to its great-grandchildren. Let us accept as an undoubted fact that a general distribution of power would enable the wants of civilised life to be better satisfied, and therefore would greatly benefit industry.

There are four methods of transmitting power to a distance:—

(1) By a moving rope.

(2) By air compressed or rarified at one end of a pipe operating an air motor at the other end.

(3) By water forced through a pipe working a water motor.

(4) By electricity.

We have an example of the transmission of power through a short distance by an endless belt or rope in the machines geared together by belts on this platform, and in the rotatory hair brushes at Mr. Hatt's establishment in the Corridor, Bath. At Schaffhausen, and elsewhere in Switzerland, the principle is employed on a large scale. Spain and other countries use it in connection with the mining operations, and lastly wire ropes replace horses on many hilly tramways. Do not look, however, for the wire rope of the Bath Cable Tramways, for cable is only to be found painted on the sides of the cars.

For short distances of a mile or so there is no system of transmitting power in a *straight line* along the open country, so cheap to erect, and so economical of power as a *rapidly* moving endless rope; but the other systems give much greater facilities for distributing the power along the line of route, are much less noisy, and far surpass wire rope transmission in economy when the rope must move somewhat slowly, as in tramway traction, or when the distance is considerable over which the power is transmitted, or when the line of route has many bends.

In the same sense that an ordinary house bell may be considered as a crude example of the transmission of power by a moving rope, the pneumatic bell at the other end of the hall, which I now ring by sending a puff of air through the tube is a crude example of the transmission of power by compressed air. Compressed air is employed to work from a distance the boring machines used in tunnelling; the continuous vacuum brakes used on many of the railways are also probably familiar to you; and the pneumatic system of transmitting power to workshops is shortly to be tried on a fairly large scale at Birmingham.

But distribution of power by water pressure is the plan that has hitherto found most favour in this country. That little water motor at the other end of the platform rapidly revolves when I work this garden syringe, and serves as a puny illustration of the transmission by water pressure. Pressure water has been employed for years on a large scale at Hull, for distributing power; also by Mr. Tweddle as a means of communicating a very large amount of power through a flexible tube to tools that have to be moved about, but the grandest illustration of this principle is the vast system of high-pressure mains that has been laid throughout London.

The economy of this system is so marked, and the success that has attended its use so great that, did I not feel sure that electricity offers a grander system still, it would be with fear and trembling that I should approach the subject of this evening, the "Electric Transmission of Power." *Punch* drew six years ago the giant steam and the giant coal looking aghast at the suckling babe electricity in its cradle. That babe is a strong boy now, let the giant water look to its laurels ere that boy becomes a man. For the electric transmission of power even now bids fair to suppass all other methods in

(1) Economy in consumption of fuel.

(2) More perfect control over each individual machine, for see how easily I can start this electric motor, and how easily I can vary its speed.

(3) Ability to bring the tool to the work instead of the work to the tool. This rapidly rotating polishing brush, with its thin flexible wires conveying the power, I can handle as easily as if it were a simple nail-brush.

(4) In greater cleanliness, no small benefit in this dirty, smoky age.

(5) And lastly, there is still one more advantage possessed by this electric method of transmitting power that no other method can lay claim to—the power which during the daytime may be mainly used for driving machinery, can, in the easiest possible way, be used during the night for giving light. I turn this handle one way and the electric current coming by one of these wires and returning by the other, works this electric motor; now I turn the handle the other way, and the current which comes and returns by the same wires as before keeps this electric lamp glowing. It might be said that the transmission of power by coal gas which I have excluded from my test fulfils that condition, but so also does the transmission of power by a loaded coal wagon. In both these cases, however, it is fuel itself that is transmitted, and not the power obtained by burning the fuel at a distant place.

(To be continued.)

The British Association.

THE final meeting of the General Committee was held on the afternoon of the 12th inst. It was reported by Professor Williamson, as treasurer, that 1,984 tickets had been issued at this meeting to members and associates; there were 266 old life members who had attended the meeting. There was an accession of 36 new life members. Three hundred and ninety nine old annual members had attended, and 100 new annual members; 639 associates, 509 ladies, and 35 foreign members. The sum received for the tickets was £2,107. Professor Williamson added that the attendance of old life members and of old annual members had been decidedly above the average, and that showed that there was an increasing number who took a continuous interest in the work of the Association. One evidence of that continuous work is the number of committees that are appointed to investigate special questions and continue researches. To a large number of these committees, but not to all, grants of money are made, and all make reports to the annual meeting. Most of these are formally presented to the section concerned and thus do not come under general observation, but in the aggregate they bear testimony to an enormous amount of voluntary labour, and embody a mass of scientific information bearing upon problems in process of solution. The following money grants were now submitted to the General Committee by the Committee of Recommendation:—

MATHEMATICS AND PHYSICS.

Ben Nevis Observatory	£50
Electrical Standards	100
Electrolysis	20
Solar Radiation	10
Differential Gravity Meter	10
Nomenclature of Mechanics	10
Calculating Tables of certain Mathematical Functions	10
Seasonal Variations in the Temperature of Lakes, Rivers, and Estuaries	30

CHEMISTRY.

The Influence of the Silent Discharge of Electricity on Oxygen and other Gases	£10
Methods of Teaching Chemistry	10
Oxidation of Hydracids in Sunlight	10

GEOLOGY.

Geological Record	£80
Erratic Blocks	10
Volcanic Phenomena of Japan	50
Volcanic Phenomena of Vesuvius	20
Fossil Phyllopoda of the Palæozoic Rocks	20
Higher Eocene Beds of the Isle of Wight	15
Fossil Plants of the Tertiary and Secondary Beds of the United Kingdom	15

BIOLOGY.

Zoology and Botany of the West India Islands	£100
Marine Biological Association	200
Flora of China	25
Naples Zoological Station	100
Physiology of the Lymphatic System	25
To Improve and Experiment with a Deep-sea Tow Net, for opening and closing under water	10
Natural History of the Friendly Islands	100

GEOGRAPHY.

Geography and Geology of the Atlas Ranges	£100

ECONOMIC SCIENCE AND STATISTICS.

Precious Metals in Circulation	£20
Variations in the Value of the Monetary Standard	10

MECHANICAL SCIENCE.

Investigation of Estuaries by Means of Models	£100
Development of Graphic Methods in Mechanical Science	25

ANTHROPOLOGY.

Effect of Occupations on Physical Development	£20
North-Western Tribes of Canada	150
Editing a New Edition of Anthropological Notes and Queries	50
Calculating the Anthropological Measurements taken at Bath	5
Exploration of Roman Baths at Bath	100
Characteristics of Nomad Tribes of Asia Minor	30
Corresponding Societies	20
	£1,645

The Committee also recommended the appointment of a number of committees to whom grants are not made.

The President explained that already £300 had been given to the Marine Biological Association, and a further contribution of £200 would entitle the Association to certain privileges in the management. With respect to the Roman baths in Bath it had been felt that, having regard to the great value and interest attaching to them, it was most desirable that everything should be done for their preservation. Appreciating the active steps taken with that object at considerable cost by the Corporation, it was felt that it would be a gracious and proper thing on the part of the Association to express its gratitude for the cordiality of its reception by subscribing £100 towards the much larger cost incurred. It did not seem courteous to appoint a committee to interfere with the committee of the Corporation, and, therefore, the grant would be made to the Mayor for the Corporation.

The recommendations of the Committee were approved.

It was also resolved to memorialise the Government in favour of a permanent census sub-department, and the taking of the census every five years.

It was further resolved that the Corporation of Bath should be urged to lay bare a further portion of the Roman baths, and, with a view to the permanent preservation of the part already laid bare, that it should be protected from the weather.

The Committee then adjourned till Wednesday, Sept. 11th, 1889, at Newcastle-on-Tyne.

SECTIONAL MEETINGS.

FULL REPORT OF THE DISCUSSIONS.

[FROM OUR OWN REPORTERS.]

MATHEMATICAL AND PHYSICAL SECTION.

(*Continued from p.* 286.)

WEDNESDAY, SEPTEMBER 12TH.

Professor G. F. FITZ GERALD, M.A., F.R.S., presiding.

The report of the Committee on the *Nomenclature of Fundamental Units of Mechanics* was read, and Mr. P. T. MAIN presented A report on *Our Experimental Knowledge of the Properties of Matter*. Professor H. A. Rowland lectured on *Maxwell's Equations for Electro magnetic Waves*, and a discussion occupying some time ensued.

Major-General BABBAGE read a paper on the *Mechanical Arrangements of the Analytical Engine of Charles Babbage, M.A., F.R.S.* No discussion followed.

Professor JOSEPH KLEIBER, of St. Petersburg, instructed the section on *The Error of the Argument of Statistical Tables*, illustrating his lecture with numerous diagrams.

Mr. C. T. DIXON then read a paper on the *Fourth Dimension*, and Sen. C. TONDINI DE QUARENGHI discoursed upon *A Suggestion from the Bologna Academy of Science towards an Agreement on the Initial Meridian for the Universal Hour.*

This concluded the work of the section.

ECONOMIC SCIENCE AND STATISTICAL SECTION.

(*Continued from p.* 297.)

WEDNESDAY, SEPTEMBER 12TH.

Mr. INGLIS PALGRAVE again presided at this section.

Professor EDGEWORTH read a paper on *The Malthusian Theory*, which had been prepared by Mr. EDWIN CHADWICK. Local interest attached to this paper from the fact that Malthus lies buried in Bath Abbey.

Mr. GEORGE GIBBONS, of Tunley Farm, Bath, read a paper on *Dairy Industry*. He said the dairy industry was one of the oldest and most important with reference to occupation, and traced its development to the present time.

The reading of the paper was followed by a slight discussion, in which Mr. Botley, Mr. Macnight, Mr. Higgins (Shepton Mallett), and others took part.

MECHANICAL SECTION.

(*Continued from p.* 300.)

WEDNESDAY, SEPTEMBER 12TH.

Mr. W. H. PREECE, F.R.S., presiding.

Col. ROWLAND R. HAZARD read a paper on *Underground Railway Communication in Great Cities.*

Perhaps the most important physical problem, growing out of the concentration of great population in limited areas, was the construction, maintenance, administration, and uses of the public streets. These, absolutely indispensable for purposes of ordinary traffic, fulfilled many other requirements of public necessity or convenience, but should be so constructed as to provide for many others of capital importance, growing out of the multiplying wants incident to the demands of modern civilization.

The main thoroughfares of traffic should be reconstructed, substantially upon the plan of superficial subways and galleries, illustrated by a model and sketches shown. Between the lines of curb the substance of the street should be removed to a standard depth of twelve feet, and the excavation so made replaced by four centrally placed subways, the two interior ones being devoted to rapid transit or fast railway trains, operated at great speed between few stations. This form of railway service, essential to economy of time and the proper development of suburban population, was not now performed at all in any great city. The two exterior subways being devoted to "way" or slow trains, operated rapidly between frequent stations, for the convenience of every district on the line for shopping, and also for supplementing the more rapid long journeys of the express line.

These railways to be operated by electric-motors and solid trains, specially devised for the service and embodying provisions for safety and comfort to a degree which apparently precludes the possibility of serious accident. On either side of these centrally disposed railway subways were placed continuous galleries calculated for the housing, inspection, replacement, and repair of all pipes and wires of communication, sewers for local service, water mains and supplies, gas mains and service pipes, steam service pipes, pneumatic power, post, parcel, refrigerating and time tubes, electric wires for arc and incandescence lights for street and private use, for power, signals, telegraphs, telephones, etc., and all other essentials or conveniences which are more profitably generated or produced at some central station, and can be distributed or served only through the public domain, overhead or underfoot, and which from the want of such common accommodation were now used—if at all—to a limited extent, at great cost and inconvenience to the authorities, the corporation, and the public.

It was also imperative that the whole subway system should be adequately supplied with fresh air in movement, so that ventilation should be as perfect as in the best arranged dwellings. This was effected by closing the railway subways from any communication with the surface of the streets except through the station doorways, and ventilating the stations by shafts supplied with electric-exhaust-fans placed in the rear of the entrance buildings, the supply of fresh air being derived from similar shafts placed in the rear of the opposite building; by this means the air of the stations will be absolutely renewed as frequently as required. The railways from open cylinders from station to station, and the trains being of approximate cross-section constitute loose pistons always moving in the same direction; the effect is the establishment of a ventilating current within the subways dependent for its force upon (1) the approximation of cross-sections, (2) the speed of the trains, and (3) the integrity of the tunnels or subways.

As the products of artificial combustion will be excluded as far as possible, the requirements of ventilation are reduced to a minimum and perfectly performed.

Reference was made to a new material, "ferflax," composed of braided steel wire, and flax-fibre, chemically treated under hydraulic pressure, devised for the wall panels of the subways, and for the construction of the railway carriages, a compound building material not unlike horn in character, having a strength and flexibility somewhat exceeding steel wire netting; a toughness approximating horn, non-fragile and unbreakable by bending, not liable to shatter under shock.

The adoption of this system for the streets of every great city would effect an economic revolution. There would be rapid communication between distant points within the metropolitan areas; there would be rapid communication between frequent stops for the convenience of local traffic and shopping; the streets would be brilliantly lighted by electricity, every house on the line would have access to gas, steam, water, the telephone; telegraph, pneumatic tube, electric light, and compressed air at will. Small industries would flourish, because small and cheap power from remote stations would be everywhere available, while the surface of the streets could be maintained in a perfect state, with the minimum of cost, and with complete immunity from disturbance, other than for the repair of worn surfaces.

Sir FREDK. BRAMWELL said this obviously was a question which could only come into existence if it would pay. He desired to know what the cost per yard or mile of such an undertaking would be. No one could doubt the desirability of having this system. Would there be such a reward to those who undertook the work as to justify its structure?

Col. HAZARD said, in answer, it would be quite impossible to fix any exact sum, as labour and material varied so much in different parts. The cost would be very much less in London than in New York. The estimated cost would be somewhere about £400,000 per mile. After answering a question how the sewage would be dealt with in this system,

Sir FREDK. BRAMWELL said the paper dealt with two subjects. One was the question to which he had paid attention for some time past, for subways for pipes and for the means required to pass along the telegraph wires, and so on. The other was the question of underground railway communication. The gallant gentleman had referred to the obstruction in carrying out underground railways in England which was caused by legislative interference. He gave as an illustration the strenuous efforts which he and others had to put forth in obtaining a subway in Southwark-street. He did not think with the author as to the interruption of traffic caused by these subways, and gave it as his opinion that there need be absolutely no interruption to traffic during the working hours of the day. He referred further to what he characterised as "the hideous rectangularity" of the streets in America. He deprecated this on the score of peace to the mind and on the score of more ready communication from one point to another under certain circumstances.

After other gentlemen had spoken, the author enlarged upon Sir Frederick Bramwell's remarks on the rectangularity of streets in America, pointing out that owing to the way the streets were built they acted as tunnels, and the wind swept through them with tremendous violence.

Mr. W. H. DOUGLAS gave full particulars as to the construction of *an Annual Winding Clock.*

A discussion ensued, in which the CHAIRMAN thought this clock would prove a great boon to the public. It seemed to him to possess all the attributes for making it, in due time, a true time-keeper for the year. It seemed to be the general opinion that the temperature affected this clock, and that something would have to be done in improving this point.

Mr. H. DAVEY contributed a paper on *A New Form of Air Compressor for Variable Pressures*, and

Mr. A. WINTER read a paper on *Controlling the Direction of Rotation of a Dynamo.*

R. A. PROCTOR.

SCIENCE, in its most beneficent field of operation, that of morally elevating all mankind, has suddenly lost one of its ablest and most effective workers.

Richard Anthony Proctor was essentially and typically a man of genius. He was nobody's disciple, nobody's pupil, he belonged to no school, he followed no precedent, was the product of no course of academic or other course of education outside himself.

It is true that he studied and graduated at Cambridge, earning distinction there in mathematics, but he broke away from the established routine of collegiate advancement, and climbed the rugged mountain of physical science by a pathway which he not only hewed and paved for himself, but left open for the use of all who may choose to follow him.

In this latter consisted his highest and his peculiar merit.

He conducted original researches, and was exuberantly fertile in original suggestive speculation, but his work in these directions was not used as scientific capital to be invested in office or professorship hunting, was not merely buried in the "Transactions" of learned societies which are read only by experts, but all was freely spread abroad for the benefit of all, and in such wise that all might easily reach and use it.

Any man of average ordinary intellect and industry may learn the contents of science text-books, and "get-up" all that is required for passing examinations in science; and having done this may reproduce the matter of the books he has read and the lectures he has heard, and thus become an ordinary Professor of Science, or writer of ordinary treatises and hand-books for the use of ordinary academic students. This is so nearly mechanical that it ranks only a few degrees above the acquisition of dead languages—the translating of Homer etc.

But there is also another class of scientific students, those who do not merely *learn* science, but who assimilate it, who absorb it into their very souls as psychic nutriment, and thus become scientific in their essential nature. When these men teach they are not quoting, not copying nor reproducing the works of any master, however great, but are producing works of their own, as the true artist paints an original picture, though composed of elements common to all pictures. Proctor was an eminent example of such great masters in original scientific exposition.

Proctor boldly attacked one of the most difficult problems presented to the teacher of science, that of simplifying complex mathematical processes and results, and presenting them in such form as to be intelligible to the non-mathematician. No mere learning of lessons can enable a man to do this. He must master the whole subject in itself, must make it his own. The machinery of mathematical formulæ is absolutely necessary for the performance of certain quantitative scientific work, and must be used accordingly, but writers who pepper their pages with algebraic equations for the expression of simple laws that can be expounded in plain, ordinary language are either pedantic mental pretenders, or intellectual cripples that cannot traverse scientific ground without the aid of symbolic crutches; they are those who have learned to formulate, but cannot reason.

Proctor's popular treatises were by no means devoted to merely the rudiments of his subjects. He presented on the popular platform those more recondite questions previously regarded as appertaining only to the altars of the high-priests of science; he not only told his uninitiated readers that the sun is so many millions of miles distant from the earth, but struggled to teach them the details of the methods of determining the solar parallax, and in doing so detected a serious blunder made by the late Astronomer-Royal in reference to the transit of Venus, a mistake that was corrected only just in time to save our expeditions from a humiliating fiasco. He revelled in thus unravelling mathematical complexities, and even carried his mathematical propensities into his recreations, his whist and chess problems, and to the mathematical demonstration of the folly of the gambler. We believe that he acted imprudently in this, but he laughed at our ideas on this subject, which are that a man who works with his brain should play with his muscles, that the brain-worker should scrupulously abstain from intellectual recreations. Navvies should play at chess, philosophers may play at skittles, on the principle that recreation should afford rest to the hard-worked faculties, and exercise those that are otherwise left dormant. Like most of Proctor's friends, we feared that he would suffer cerebral collapse on account of his insatiable love of intellectual hard work.

It was not until we had seen him at home with his family, and wheeling his little sickly son on the Brighton pier, that this apprehension was removed. Then the wisdom of his second marriage became evident, the widower had found a helpmate who could win him away from severer studies to revel in music and pictorial art, in lively social converse, and the prattle of little children; for now there were three loving families, the first family of the widow, that of the widower, and those of the second marriage.

All who have had the pleasure of thus knowing Mrs. Proctor must deeply sympathise with her terrible affliction, as all such must have seen that the marriage was a genuine love-match, subsequently sustained by mutual respect and admiration.

In the days of his widowhood, when he lived at Clapham, we only met him on purely scientific ground, and was told by those who knew him more intimately that he was then a recluse and rather morose; but at Kew he was all the opposite of this, the difference due no doubt to his brilliant and gentle partner, than whom no one could be more suitable to such a man, nor no man more suitable than Proctor to such a woman.

His faith in the infallibility of mathematical results was curious, seeing that he had successfully refuted some of the accepted conclusions of very eminent mathematicians. His own mathematical self-righteousness maintained him in a perpetual Donnybrook, and those who only knew his controversies in their printed form commonly supposed him to be ill-tempered. This, however, was not the case; he was really as amiable as the habitual smile of his somewhat feminine features indicated.

We dwell upon this, knowing that considerable bitterness exists in the minds of many who have had controversies with him, and in this hope that all this will now be healed by making fair allowances for errors due to overwork and an earnest devotion to the purity of science, which occasionally led the great teacher into a somewhat Quixotic eagerness to defend it against the inroads of real or supposed fallacies.

INTERNATIONAL GEOLOGICAL CONGRESS.

THE opening of the International Geological Conference took place on Monday evening, the 17th inst., at the London University, Burlington Gardens, the committees on nomenclature and on the map of Europe having held sittings at the same place earlier in the day. At the evening meeting, which was attended by a large and distinguished company, a short address was delivered by the outgoing President, Professor Beyrich, of Berlin, after which a letter from Professor Huxley, the new Honorary President, who is now in the Engadine, was read, expressing his great regret that the state of his health did not allow him to be present. Sir Douglas Galton having in a brief, telling speech bade the strangers and foreigners welcome, and M. Capellini, Rector of the University of Bologna, having made a suitable reply, the new President, Professor Prestwich, assumed the chair, and delivered the opening address in French.

The following is a translation of Professor Prestwich's address:—

I deeply regret that on account of the present state of his health Mr. Huxley is not here to offer you a welcome to England. But if we need a voice, I ask you to believe that the unanimous voice of English geologists joins in this sentiment, and thanks you, our foreign colleagues, for having responded in a manner so flattering to us to the invitation of English geologists to meet this year in London. We have in this assembly, geologists representing Germany, Austria, Belgium, Denmark, Spain, France, Holland, Hungary, Norway, Portugal, Roumania, Russia, Sweden, Switzerland, as well as the United States, Canada, Mexico, the West Indies, the Argentine Republic, and Australasia. Eminent and illustrious men from all these countries honour us with their presence, and bring their knowledge to our assistance in discussing for the fourth time the questions with which the International Congress is concerned. The number of geologists present on this occasion indicates the deep and unbroken interest which they bring to it. Among the most permanent members of the organisation are the Secretaries of the Congress and of the Committees, to whose important and gratuitous services the

Congress is much indebted. We have unfortunately to deplore the death of one of these, M. Charles Fontannes, and we lose by this blow the advantage of his long experience and his valuable assistance.

As usual, our discussions are carried on in French, as in the diplomatic world, but it is to be hoped that friendly feeling will be better preserved here than sometimes happens in the other case, where councils have not always avoided strife. If I may be allowed to speak after a personal experience of about half a century, a most cordial feeling between us English geologists and our fellow-workers and friends beyond the sea has been the normal condition during those long years. May these open and friendly relations still remain the portion of science both now and in the future.

These friendly manifestations were, however, only occasional, and there was little personal exchange of ideas. But of late, instead of the discussion of disputed questions by each nationality separately, the happy thought has been hit upon of submitting questions which concern all to the arbitration of this General Council. In this way the various national centres of our science, each of which has its local shade of character and special experience, are able to combine their results in a much broader and more uniform manner than if each were separately to follow out its own ideas based on a more limited set of observations. Nevertheless, in giving to our science the uniformity of terms and of classification which are so necessary to it, we must be careful not to subject it to bonds which clasp it too tightly and which, instead of developing, may even retard its progress. It is advisable that the bonds should be sufficiently elastic to adapt themselves to the rapid development which we must expect in geological knowledge. It is very desirable, it is even highly necessary, that we should be in agreement with regard to the colours and symbols to be employed for the various beds, rocks, and irregularities which we find in the earth's crust, but petrology is still far from being established on firm foundations, and the synchronism of beds between even neighbouring countries is not always easy to determine with accuracy, and much less between countries far apart. Let us therefore endeavour to avoid the error of congresses of arrogating to themselves an infallibility which is very little in accord with the progress of science.

And now I would say in a few words what the Congress has already accomplished, and what remains to be done.

At Bologna M. Capellini gave the history of the Congress so well that there is no need for me to touch upon it, unless it be to remind you that the idea of the Congress had its origin in America at the Philadelphia Exhibition in 1876, and no doubt this idea, like that of the Exhibition itself, was only the expression of the desire which had been making itself felt for some time of treating certain questions of science and art, not only in what we might call a national family meeting, but in a cosmopolitan assembly—to deal with the great questions which concern all mankind as belonging to the whole civilised world, and, in order to discuss them, to make of the various nationalities a brotherhood founded on their interests and their common welfare.

Congress of Paris.—At the first Congress held at Paris in 1878, the primary questions of nomenclature and classification were sketched out, as well as the rendering of geological works uniform in the matter of colours and symbols, so that the signification should be alike for all countries.

The idea which was well received at first was to make use of the solar spectrum, and to adopt the three primary colours, red, blue, and yellow, for the three main divisions of Primary, Secondary, and Tertiary rocks; the subdivisions of the second order should be distinguished by shades of these colours, and those of the third order by cross-hatchings of the same colours. But this scale was afterwards found too limited, and at Bologna as at Berlin several modifications and complementary colours were introduced into it, still, however, keeping somewhat to the original idea. As a corollary, it was suggested that the labels of fossils ought to be, as is already the case in many museums, of the same colour as that used for the bed from which the fossils are derived, so that both the horizon and the period might be seen at a glance.

As to the question of rendering the nomenclature of the great divisions of the earth's crust uniform, it was felt that in the first place it is essential to be agreed upon the terms employed, and it was seen that a geological dictionary containing the etymology or source of each geological name, the synonymy in the other languages, a definition in French, and an illustrative figure as in technological dictionaries would be most useful. The publication of such a work, which ought to be at least in six languages, has been strongly supported. Finally the study of these questions was referred to International Committees to report upon to the meeting of the Congress at Bologna.

With regard to the classification of strata, memoirs have been received on the Pre-Cambrian strata, and on the Palæozoic rocks of North America, on the Carboniferous strata and the Permian, in different parts of Europe and in America, and on the relations of the horizons of extinct vertebrata in North America and in Europe. The two last memoirs were accompanied by valuable lists of invertebrata, plants, and reptiles of various countries. These memoirs have raised very important stratigraphical and palæontological questions with regard to the wide distribution of families and genera. Each of the faunas of the primary divisions of geological time has been in part recognised as occurring equally in the two great continents, in Europe and in North America — and Mr. Cope has been led to ask himself whether the organic types are natives of a special centre from which they have spread, or whether the same types of generic structure have appeared independently at different points of the earth; and in the latter case whether they are contemporaneous or of different periods. These synchronic appearances form a subject full of mystery from whatever side we view them. The geological record is at present too incomplete for us to solve the problem. In every country there are gaps which can only be filled by the aid of observations continued in other parts of the world. To encourage these observations is one of the most useful functions of the Congress. There has also been discussed the classification of the quaternary deposits in relation with the remarkable history of the grottoes of central France, the Glacial deposits and the Dunes of Holland, the Tertiary beds of Portugal, which are limited to the Miocene and Pliocene; the Tertiary eruption rocks of Hungary, from the point of view of discovering whether there is any relation between the mineralogical constitution and the relative age of different trachytic types.

The Congress has also dealt with questions of higher physics, such as those of the deformations and fractures of the earth's crust, the alignment of faults and of moun tain chains, the origin of volcanoes, and the probable causes of earthquakes, the structure of the Alps, and the foldings of the chalk.

Less in conformity with the fundamental objects of the Congress, but having nevertheless a relation to them, were the memoirs on the Felspars, on the alteration of superficial deposits, on the employment of the polarising microscope, on the propagation of heat in rocks, and other special subjects.

The Congress of Bologna.—In the fine volume constituting the account of the meeting held at Bologna is contained the report of the International Jury appointed to judge the competition for rendering the colours and geological signs uniform, for which the King of Italy had generously offered 5,000 francs to be given for the best memoirs deemed practically applicable.

Six memoirs were received, of which the three prize ones are published with coloured illustrations which leave nothing to desire. The authors of these were of opinion that though the solar spectrum is a very advantageous fixed base, the scale of colours was insufficient, and that it would be necessary to introduce complementary colours or such as had a relation to the primary ones. The divisions, in fact, of the sedimentary beds are so numerous that it would be necessary to employ not only these colours, but also many shades of the same colours or of different hatching, reserving rose-colour for the Archæan crystalline schists.

It was agreed to use for the eruptive rocks, strong and brilliant tints of red, green, or purple, the intensity of which would render them easily distinguishable from the colours of the primary sedimentary rocks and from the clear colour of the schists. It was desired too to discriminate between the acid and the basic rocks, both by their petrological composition and by their age, in using different shades of the same colours with coloured dots or by hatching of different kinds, and with the letters of the Greek alphabet. It is proposed to show thus by symbols the principal varieties of the granitic, porphyritic, trachytic, andesitic, basaltic, and other rocks; but the varieties are so numerous that it would be difficult to know where to place the limits, and according to one of these plans it would be necessary to use seventy-six signs and hatchings of different colours. You will be able to judge of the different methods proposed by the fine plates by which the reports are illustrated. The sections taken in the mountains of Switzerland and others which serve as examples produce an excellent effect. Conventional signs are also used to indicate the inclination and direction of beds, faults, fossiliferous places, cold, warm, and mineral springs, travertines, quarries, mines, etc. A geological map will thus be a veritable hieroglyphic chart possessing a universal meaning.

As a result of the discussions held at Bologna, and in order to make a practical application of them, it was decided to publish a Geological Map of Europe on the scale of $\frac{1}{1000000}$, in which the signs and colours definitely adopted by the Congress should be employed. This map, already far advanced towards completion, is under the direction of a Committee at Berlin.

With respect to the reports on the uniformity of Geological Terms, they have been received from nine national Committees, namely, Austria, Belgium, Spain, Portugal, France, Great Britain, Hungary, Italy, Russia, and Switzerland. Besides these there are eleven from individual members. One might well imagine that among so many opinions all would not agree; but from the good-will that every one has brought to the question, although some discord has occurred on points of detail, they were almost unanimous on essential matters, and a general agreement for Stratigraphic Terms has been arrived at, such as group, system, series étage, and for Chronological Terms, such as era, epoch, age, etc., leaving to future Congresses the consideration of certain other trifling points. This subject reminds me, gentlemen, of a difficult question which you have to face. If your resolutions are voted by the voices of all the members of the Congress, the result can scarcely help showing the effect of the variable number of the nationalities according to the country in which the congress is held. For example, at Bologna there were 149 Italian members and 19 English; at Berlin, 163 Germans and 11 English; here the numbers of English and foreign geologists present is still more considerable than at preceding Congresses. Therefore if all vote, the opinion of the place in which the Congress is held will predominate too much, unless you find means of placing limits to it.

Thanks to the fairness of the Council at Bologna, the greater part of the Resolutions were passed unanimously; some few having been referred back to the various Committees for further deliberation.

As to the stratigraphical divisions, it was resolved: (1) That the term "Group" shall be applied to each of the great divisions of the Primary, Secondary, and Tertiary rocks. (2) That the sub-divisions of these groups shall be called "Systems." Thus you have Primary Group, or Palæozoic, and Silurian System, Jurassic System. (3) To the first order of divisions of the systems, the term series will be applied (Oolitic series), to the divisions of the second rank the term "Etage," and to those of the third order the word "Assise." The unit of the stratified masses is the stratum or bed. With regard to a word much used in England, and dating from the primary time of geology, the word "Formation," the majority of the Congress decided not to employ it in the sense of the French "Terrain" as we generally do, but only in the sense of origin or mode of formation, so that we should say of a bed that it is a marine formation, or fluviatile formation, etc. We must, therefore, endeavour to find some other word to replace the habitual "Chalk Formation," London Clay Formation, etc.

For the Chronological divisions corresponding to those of the stratigraphy, it has been proposed that: (1) "Era" shall correspond to "Groupe," as "Primary" or "Secondary Era;" (2) "Période" to "Système," as "Silurian Period," Cretaceous Period;" (3) "Epoch" to "Series," as "Inferior Oolite Epoch;" (4) "Age" to "Assise," as "Portlandian Age."

On the subject of colours and symbols, the final decision was delivered to the committee of the geological map, and with respect to the rules to be followed in the nomenclature of species, it was resolved that the name given to each genus and each species shall be that by which they were earliest designated, subject to the condition that the characters of the genus and species have been published and clearly defined. The priority will not go back beyond Linnæus, 12th edition, 1766.

At the Bologna Congress there were only four special and local memoirs, and those were only produced in support of collections and documents which were exhibited.

Congress of Berlin.—The official account of this meeting has only been published a few days. I greatly regret that I have not been able to avail myself of it, for my address was already printed. I therefore confine myself to a mention of it, while for my information I had recourse to the independent notices of MM. Renevier, Klebs, Choffet, Frazer, Blanford. and Dewalque. At Berlin the Congress was especially engaged upon the geological map, the committee of which, profiting by the liberty accorded by the Bologna Congress, revised the colours for the sedimentary rocks in the following manner:—

1. Actual deposits (Alluvium, etc.)	Very pale cream colour.
2. Quaternary (Diluvium)	Naples yellow.
3. Tertiary	Different shades of yellow.
4. Cretaceous	Green tints and hatchings.
5. Jurassic	Blue tints.
6. Triassic	Violet tints and dots.
7. Permian and Carboniferous	Grey tints and hatching.
8. Devonian	Brown tints.
9. Silurian	Greenish-grey tints.
10. Archean	Rose tints.

And for the ten divisions of the eruptive rocks different tints and dots of strong and brilliant red.

With respect to the letters used in addition to the tints, it was decided to employ Latin initials for the sedimentary rocks and Greek initials for the eruptive rocks. It is on the basis thus described that the large and beautiful geological map of Europe in course of preparation at Berlin will be coloured.

As to the stratigraphical uniformity, the Congress adopted in the main the resolutions passed at Bologna. The French and Portugese committees, however, proposed to replace the word "Group" by "Series" for the three great divisions of the earth's crust, so that in place of "Primary Group," &c., we should have "Primary Series." The word "Group" will then take the place of the divisions of systems, as "Oolitic Group" (instead of "Series"). This substitution will, perhaps, recommend itself to many among ourselves.

Further, on the proposition of substituting for the present different terminations, a system of terminations, in *ique*, the Committees were not unanimous. Instead of Eocenic System, &c., we should have the terms Eocenic, Siluric, &c. Is it essential to alter these ancient terms of the science? It is all very well to have such terminations for actual things, such as the crystalline and eruptive rocks, *e.g.*, granitic or porphyritic rocks, but can one submit, or is it necessary to submit, series of strata which have no character in common, to the same narrow rule, because they are all included under the same ideal name of classification? This question will no doubt be discussed, and it is for you, gentlemen, to judge what is the most fitting solution.

Among the other questions, gentlemen, which you will have to consider, is that of the classification of the Cambrian and Silurian strata. Accordingly as these two great systems have been taken in a descending or an ascending order, the division between the two has been placed lower or higher, because the breaks in the two groups are few and the palæontological connection is little interrupted. In England, Sedgwick, who began from below, found no break till he reached the Mayhill sandstone, while Murchison, who began from above, met with no check till he reached the lower limit of palæozoic life: he even hesitated. Thus, in the countries where Murchison's work is best known and where his lead has been followed, the partisans of one side have surmounted stratigraphical barriers, while the partisans of the other side have neglected palæontological arguments. In this country, their stratigraphical birthplace, the Cambrian and Silurian have been but little spread out, and it is only since the death of their founders that the palæontological proofs have increased sufficiently to indicate their distinctive character. These two systems are found elsewhere (especially in America, where there is now some discussion as to their association with a Taconic system) either more developed or with special characteristics which may enable us to determine more precisely their mutual relations. Here, too, gentlemen, the knowledge which you bring from all parts of the world may assist us to unravel this complicated question.

Amongst the other subjects which the previous Congresses have not fully discussed are:—

(1) The connection between the Carboniferous and the Permian.

(2) Between the Rhaetic and the Jurassic.

(3) Between the Tertiary and the Quaternary.

In the case where there has been no interruption of the layers or discordant stratifications, the systems pass from one to the other without an apparent break, like the colour of the solar spectrum; but, as everybody knows, if a link be missing, the sequence is broken and the line of separation of the divided layers is settled. If, for example, the Caradoc were missing from the Cambrian-Silurian, or if the Pliocene were missing from the Tertiary, there would exist between these formations a gap which would give the necessary break.

Apart from the international questions, the Congress of Berlin had several special memoirs under consideration, but as yet the details are not before us; besides, whatever may be their importance, they are less interesting for the moment than the international subjects under discussion. One of these special memoirs refers to a vast palæontological project, and the Congress has nominated a Commission of distinguished palæontologists to contribute to its realisation. The proposed work is on the plan of Bronn's "Enumerator and Nomenclator," and of Alcide d'Orbigny's "Prodrome;" but such is the progress that palæontology has made, that about fifty large volumes would be needed for the complete enumeration of all the known animal and vegetable fossils. A work of this nature would form a useful addition to the great polyglot dictionary of geological terms projected at Bologna.

These then, gentlemen, are some of the subjects which you will have to consider. You have to review, and where possible to finally decide, questions already discussed, and to examine the new points raised. Amongst them is the fundamental problem of the crystalline schists, a subject remarkable for the great progress made in it during the last few years, and for the new aspect which it has recently assumed; for it is clear now that it is not merely a chemical metamorphosis by heat, but that the subject also includes questions of weight, pressure, and of sliding movements which necessitate for their explanation the combined efforts of the physicist, the chemist, the petrologist, and the stratigrapher.

Although the majority of the subjects under consideration at the present Congress are eminently practical and positive, they include theoretical points of the greatest interest. The classification of the formations, and their synchronism, rests as much upon stratigraphy as upon palæontology. In order to determine their relations, the identities as well as the difference of the fossil species must be noted, and it must be ascertained whether the sequence in distant countries follows the synchronic or merely the homotaxic arrangement. In one case it can scarcely be hoped that the same species will be found; in the other the identity of the species may be taken as a contrary proof, provided one does not agree with Edward Forbes that the species have had more than one centre of origin. To resolve these questions we must trace the dawn of life, the appearance, the duration, and the disappearance of the species, and of the source from which they came. Must we believe in the evolution of the species, or must we regard them as buds of short duration and the genera or families as the branches or permanent shoots. If I have permitted myself to discuss these problems of fact and of theory, it is not to venture on an opinion but only to indicate the vastness of the field, and how much collaboration and time will be occupied in making all the necessary studies. It must not be thought that the work of the Congress is completed when the fundamental questions have been discussed; unanimity established on the international facts will but clear the way, and the cosmopolitan theories already discussed, together with those which may arise, will provide ample materials for the future labours of the International Congress.

Dr. T. Sterry Hunt, of Montreal, then proposed a vote of thanks to the President for his address, Dr. von Zittel, of Munich, seconding the motion. The formal passing of the vote of thanks brought to a close the proceedings,

At 9 o'clock Professor and Mrs. Prestwich held a reception in the Library, in which has been arranged a large and valuable exhibition of objects of geological interest, mainly illustrative of the questions to be discussed before the congress. Contributions to the exhibition in the form of maps, rocks, fossils, &c., have been received from geologists all over Europe, as well as from many well-known English scientists. Dr. Geikie sent a number of maps illustrative of the peculiar geological structure of the North-west Highlands, together with a collection of rock specimens from the same district. Professor Heim, of Zurich, exhibited a very interesting collection of rocks and fossils from Switzerland, showing the contortions of the strata effected by pressure; and Dr. H. J. Johnston-Lavis, of Naples, sent some equally interesting specimens of more or less stratified limestones (in different stages of metamorphism) ejected from Monte Somma. A large series of Precambrian rocks from North Wales were contributed by Dr. Hicks; and a series of Monian rocks and slides, illustrating the various methods of metamorphism and their results, with regard to Anglesey rocks, by Professor Blake. Professor Prestwich, the president, sends a collection of plants and marine fossils from the coal measures of Coalbrook Dale, together with some peculiar types of flint implements from the Quaternary river drifts of France and England. From the office of the Geological Survey of Italy a large number of maps and rock specimens were sent; and Professor Judd showed a very interesting collection of samples from the borings in the Nile Valley conducted by the Royal Society. Dr. G. J. Hinde exhibited a number of specimens of siliceous rocks from the carboniferous strata of Yorkshire. Ireland, Wales, and Spitzbergen, showing their derivation from the remains of siliceous sponges. A very large and remarkable series of palæolithic implements from various localities, British and foreign, were contributed by Dr. John Evans; and an unusual collection of objects illustrating the stone-age deposits of Crayford were sent by Mr. Spurrell. Mr. Mark Stirrup brought together a series of boulders found in the coal measures of Lancashire, and there was also exhibited a large collection of wonderfully preserved fossil plants from the Eocene formation of the Isle of Mull. Some interesting specimens of spheroidal concretions occurring in granite, and others of Itacolumite, or flexible sandstone, were sent by Dr. Hatch and Mr. R. D. Oldham respectively. The exhibition was too large to be described at all exhaustively, but the foregoing remarks will supply an indication of its scope and interest.

The entire arrangement and organisation of the exhibition were in the hands of Dr. Hinde and Mr. J. Teall, together with several voluntary assistants.

NOTICES.

METEOROLOGICAL RETURNS

for the ten weeks ending on Monday, Sept. 10th, 1888. Specially prepared for SCIENTIFIC NEWS from official reports.

	Mean Temperature.	Rainfall.	Duration of Sunshine.
Scotland, East	53·5 degs., being 3·4 degs. below average.	6·5 ins., being 0·5 ins. below average.	277 hrs., being 87 hrs. below average
England, N.E.	55·0 ,, ,, 3·3 ,, ,, ,,	8·6 ,, ,, 2·4 ,, above ,,	238 ,, ,, 103 ,, ,, ,,
England, East	57·3 ,, ,, 3·8 ,, ,, ,,	8·1 ,, ,, 2·5 ,, ,, ,,	284 ,, ,, 118 ,, ,, ,,
Midlands ...	56·3 ,, ,, 3·9 ,, ,, ,,	7·5 ,, ,, 1·2 ,, ,, ,,	285 ,, ,, 85 ,, ,, ,,
England, South	58·0 ,, ,, 3·0 ,, ,, ,,	7·1 ,, ,, 1·8 ,, ,, ,,	304 ,, ,, 110 ,, ,, ,,
Scotland, West	54·7 ,, ,, 2·0 ,, ,, ,,	9·1 ,, ,, 0·5 ,, below ,,	285 ,, ,, 75 ,, ,, ,,
England, N.W.	55·8 ,, ,, 3·6 ,, ,, ,,	9·2 ,, ,, 1·7 ,, above ,,	279 ,, ,, 73 ,, ,, ,,
England, S.W.	56·7 ,, ,, 3·3 ,, ,, ,,	9·5 ,, ,, 1·2 ,, ,, ,,	360 ,, ,, 82 ,, ,, ,,
Ireland, North	55·9 ,, ,, 2·8 ,, ,, ,,	8·7 ,, ,, 1·1 ,, ,, ,,	257 ,, ,, 32 ,, ,, ,,
Ireland, South	56·6 ,, ,, 2·4 ,, ,, ,,	7·7 ,, ,, 0·2 ,, ,, ,,	345 ,, ,, 1 ,, above ,,
The Kingdom...	56·0 ,, ,, 3·1 ,, ,, ,,	8·2 ,, ,, 1·1 ,, ,, ,,	291 ,, ,, 76 ,, below ,,

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CONTENTS.

SCIENTIFIC TABLE TALK.

By W. Mattieu Williams, F.R.A.S., F.C.S.

Nearly allied to the glacier tables described in my last are the glacier cones, but their history is rather more complex and very interesting. The glacial ice river is a paradoxer, some of its doings contradicting point blank the orthodox proceedings that are predicated as those of ordinary rivers. Thus on the glacier heavy masses float and even rise above the general level, while such filmy trifles as a fallen leaf or dead butterfly sinks to considerable depth, because it is filmy.

A dead butterfly falling on a glacier digs its own grave, and then raises a monument to its own memory, the height of such monuments varying from 6 to 8 inches to 6 and 8 feet, with about the same diameter at the base.

But what have butterflies to do on glaciers? the reader will ask. The answer is that their business there is simply to die. They are carried by the wind from the fields and gardens below, are killed by the cold, and fall upon the ice. They are even found on the nevé far above the glacier. When I ascended Mont Blanc, two were found on the Grand Plateau at an elevation of about 12,000 feet, and were kept as memorials of the ascent by the junior guides who found them. They are commonly found in making such ascents.

Most of my readers will remember Franklin's celebrated experiment of placing pieces of cloth upon snow exposed to winter sunshine, how they thawed the ice beneath and sunk to depths varying with their colours. The loose superficial structure of a butterfly coated with microscopic feather scales is a remarkably good absorber of radiant heat, and being exposed to the summer sunshine acquires a high temperature.

As the heat thus absorbed readily passes through so thin a film as the butterfly's outspread wings, the ice below them is more rapidly thawed than that of the less absorbent naked ice around, and thus a hollow is formed under the butterfly, into which it sinks, while heavy masses of rock protect the ice below them and, as already explained, stand above the general level on moraines and ice cones.

Let us now consider how the butterfly sinks, and the necessary consequences that follow such sinking. On a glacier with so little slope as the Unteraar the hollow under the butterfly remains filled with water, and the butterfly rests lightly on the bottom of this little pool. The thawing action continues as at first, so long as the depth is small enough for the radiant heat to pass effectively through the water.

After this another and very different action commences. The temperature of water in contact with ice is 32° Fah. When raised any temperature between 32° and a fraction above 39°, its density increases proportionately, and therefore the water thus warmed will sink below other water remaining at 32°.

The watery grave of the butterfly when exposed to the rays of the summer sun is superficially warmed, but immediately the temperature of the surface water exceeds 32°, it sinks, and cooler water rises to take its place. The warmer water in its downward course strikes and thaws the ice walls and bottom of the grave, and thus continually digs it wider and wider and deeper and deeper, but this widening and deepening does not occur equally on all sides. The south wall of the grave is in shadow from about 6 a.m. to about 6 p.m., most deeply so at midday, when the sun is working the most effectively. The solar grave-digging is therefore the most vigorously conducted on the north side of the excavation, both as regards walls and bottom. It is thus elongated northwards, and deepened on the north side. This proceeds to such an extent that the bottom of the grave becomes a rather steep incline, from due north upwards to due south, in the direction of the longer axis of the now elliptical pool.

We were shown several of these in various stages of development. Into those that were far advanced we thrust our alpenstocks, which, after a little preliminary reeling, stood aslant, pointing due south with remarkable accuracy, and also pointing upwards with a respectable approximation to sun's meridian attitude at the place and season. This is easily understood when we reflect upon the action above described. The stick falls to the lowest point it can attain; in doing so its lower part occupies the deepest end of the elliptical pool, and it leans against the longest incline of the wall, which extends from north to south.

These pools have accordingly received the name of meridian-holes (*trous meridionales*). By their aid a traveller in a fog, and without a compass, may at once find his geographical bearings.

It is easy to understand that this kind of excavation may be carried on much further. So long as the water can freely circulate, the warmer water will continue to sink from the surface, and, when it is cooled down to freezing point by its work of thawing, will rise again, and this circulation may continue to any extent. In some instances it does so continue for a long time, and thus the little meridian hole grows to a deep, wide pit in which some of the meridional features become partially obliterated, but the elliptical form remains. On the Unteraar glacier I saw several of these quite large enough to justify the name given to them by our merry mentors, who called them *Baignoires*, or bathing tubs, and invited us to use them freely. Agassiz describes examples reaching a length of 10 to 12 ft., a breadth of 3 to 4 ft., and depth of 20 ft. He calls them "*Wasserbecken*," water basins.

The ablation or thawing down of the glacier described in my last necessarily supplies a large quantity of superficial water. During the summer day-time the glacier is alive with rills and streamlets of varying dimensions, flowing along furrows of their own making, but their course is usually short, in many glaciers very short. They usually flow on until they reach a crevasse or chasm, such as abound on the steeper glaciers; then pitch down this to contribute to the waters of the subglacial tunnel which traverses the bottom of every glacier.

But the Unteraar glacier being so nearly level has but few crevasses, and these are far between; therefore it becomes easily possible for such rills to encounter a baignoire. Two opposite results follow from this. If the water of the streamlet is moderately clear it deepens the pit, and may go on thus deepening it until it forms a deep well in the ice, that may even reach to the bottom of the glacier. This occurs when the quantity of clear water is great. Such wells are named *trous de cascade*, as when fully developed, and reaching the bottom of glacier, all the water they contained in their bathing-tub stage is drained away, and flows under the ice. Thus the baignoire is converted into a deep hole with perpendicular crystal sides, down one part of which an eroding cascade is falling. Agassiz measured the depth of one of these near to the Hotel des Neufchatelois, and found it 260 metres (853 feet) deep, thus affording a measure of the thickness of the ice at that part.

If the rill that falls into the baignoire carries with it much sand and gravel the butterfly's monument is erected. How this comes about may in the meantime stand as a physical problem for my readers to work out, and compare their solution with that which I shall supply next week.

GASEOUS FUEL.

A Paper Read by Mr. J. Emerson Dowson, M.Inst.C.E., before the Mechanical Science Section of the British Association.

(Continued from page 309.)

To determine the working cost of a gas engine driven with this generator gas, compared with a steam engine and boiler, the more simple and direct way is to take in each case the weight of fuel used per h.p. per hour, as it is no more necessary to determine the volume of gas consumed than it is to know the volume of steam used. We have already seen that with this gas the fuel consumption of several Otto engines doing practical work in different places averages only $1\frac{1}{3}$ lbs. per indicated h.p. per hour. The wages of the attendant, the cost of repairs, and the other working expenses are about the same as with a steam engine of equal power. The great difference is in the consumption of fuel, and to make an exact comparison I have taken the returns last published by the Manchester Steam Users' Association, for all engines indicating under 100 h.p., for which the net fuel consumption is given. The details of these returns will be found in Appendix II. of my Institution of Civil Engineers paper before referred to, and from these it appears that the average fuel consumption is 7 lb. per indicated h.p. per hour. If, however, an average be taken of 5 engines, each indicating 20 h.p., the fuel consumption will be over 11 lb. per indicated h.p. per hour. It is instructive too to note what Sir Frederick Bramwell said on the fuel consumption of steam engines in actual work, in his address (January, 1885) as President of the Institution of Civil Engineers. He said:—"In an investigation instituted last year by the Corporation of Birmingham, when considering whether they should approve of a proposal to lay down power-distributing mains throughout their streets, it was found on indicating some six non-condensing steam engines, taken indiscriminately from among users of power, and ranging from 5 nominal h.p. up to 30 nominal h.p., that the consumption in one instance was as high as 27·5 lb., while it never fell below 9·6 lb., and the average of the whole was as much as 18·1 lb. per indicated h.p. per hour."

It is quite true that in competitive trials at the Royal Agricultural Society's shows the fuel consumption of the best portable engines working under the most favourable conditions for a short time is slightly under 2 lb. per indicated h.p. per hour, but this result can only be obtained by the most careful nursing of the fire by highly-paid skilled attendants who salt the fire, so to speak, with a slight sprinkling of coal at very frequent intervals. In any case we may safely say that with gas power the fuel consumption under ordinary working conditions is at least 50 per cent. less than with non-condensing steam engines of equal power. With gas there is the further advantage that it can be conveyed to any part of the works without appreciable condensation, that separate engines can be used for different lines of shafting, and that any department working overtime can have its engine supplied with gas from a single generator. With steam, however, there is much condensation if it be carried far, and much loss of fuel if a large boiler has to be fired to keep a small amount of shafting at work.

I have so far confined my remarks chiefly to the application of improved generator gas to motive power, and there is no doubt that the recent departure in this branch of mechanical science is one of great importance. I am, however, glad to add that a considerable advance has also been made in the use of this gas for heating of various kinds.

At the Gloucester County Asylum it has been in daily use for a variety of purposes for about five years. All the kitchen work for the staff and inmates is done with it, and there is no ordinary fire in the kitchen. About 300 quartern loaves are baked with the gas every day at a cost of about one shilling only for fuel. The gas is also used for two 12 h.p. (nominal) Otto engines, which pump water, and drive a dynamo for electric lighting. The average cost of the gas is about 2d. per 1,000 c. ft., including wages, repairs, and all incidental expenses, or about 8d. for the equivalent of 1,000 c. ft. of ordinary lighting gas. The anthracite costs about 13s. per ton.

This gas is used on a large scale at the cocoa works of Messrs. Van Houten & Son, of Messrs. Cadbury Brothers, and of Messrs. Russ-Suchard & Co. Careful trials at the first-named works showed that the cost was under 1¾d. per 1000 c. ft., or only 6½d. for the equivalent of 1000 c. ft. of the town lighting gas, with which comparative tests were made. The anthracite costs 16s. per ton.

Messrs. Onderwater & Co., of Dordrecht, use the gas for heating the drying chambers in their large starch works. Messrs. Guittet, of Herblay, have for some years used it for making varnish, and they not only effect a considerable economy, but they avoid risk of fire from the boiling over of the oil and gums, and this of itself is an important consideration in varnish works.

The gas is also used by the Société Nestlé for soldering their condensed milk tins, and more recently it has been adopted by Messrs. Huntley, Bourne, and Stevens, of Reading, not only for soldering biscuit tins, but for heating a large number of ovens in which japanned and varnished goods are baked.

Messrs. Hillman, Herbert, and Cooper use it at their Coventry works, and in Germany, for brazing with blowpipes the joints of bycicles and tricycles as well as for enamelling.

On the Continent several firms use the gas for singeing silk yarns and textile fabrics. It is also used by several linen manufacturers in the North of Ireland for stentering, which was formerly done with hot air.

This gas is also used for melting type metal, for heating hat forms, and for other work in a hat manufactory. It has also been adopted for glass-blowing in an electric-lamp factory, and for many other industrial purposes. I have, however, mentioned enough to show that gas of this kind can be and has been produced and applied successfully, and there is every reason to believe that its use will extend, especially as the gas-making apparatus is easy to work. I am not at liberty to state the annual saving effected by several firms who use the gas, but it is very considerable. The cost of the gas somewhat depends on that of the fuel and on the scale of working, but, speaking generally, the equivalent of 1,000 c. ft. of ordinary lighting gas costs from 6d. to 1s. Compared with solid fuel, gas has certainly many advantages—it is under complete control, the heat derived from it can be kept constant or varied at will, it is comparatively easy to insure complete combustion with but little chimney draught, it is more economical, and there is an entire absence of smoke. When solid fuel is used, it is necessary to introduce more than twice the quantity of air theoretically required for combustion, in order to drive away the products of combustion and to insure a sufficiency of oxygen being brought into contact with the surfaces of the fuel. This large supply of air can only be drawn in by a strong chimney draught or other artificial means, and this causes a very rapid withdrawal of heat from the fire. Further than this there is invariably some escape of smoke and partially burnt carbon in the form of carbonic oxide.

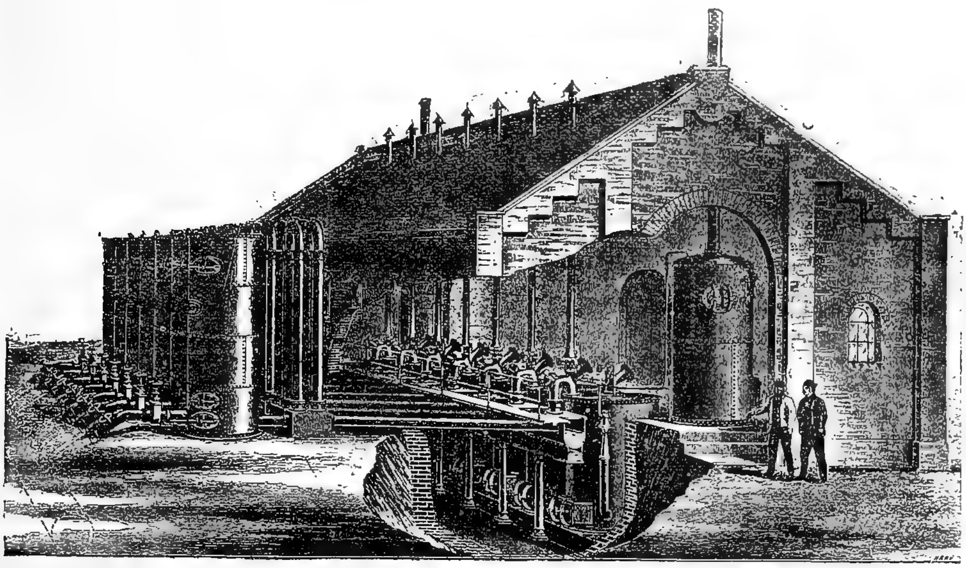


Fig. 3.—The Dowson Gas Plant on a Large Scale, as used at the Cocoa Works of Messrs. Van Houten and Son, Holland.

It is admitted that there is a demand for fuel gas, but for many purposes the ordinary lighting gas is too expensive, and the mere fact that it is made for lighting renders it so expensive. The percentage of illuminating constituents in coal gas is indeed very small —20 candle-power gas containing about 6½ per cent., and 16 candle-power gas, as in London, containing only about 4 per cent. The remaining 93½ or 96 per cent. is composed of non-luminous heating gases, but the addition of this small proportion of illuminants adds greatly to the trouble and cost of producing the gas, and any great reduction of its present cost is improbable. It is therefore rational to suppose that for fuel purposes the lighting constituents should be dispensed with.

Assuming that we have a good and cheap fuel gas there remains the question of how to apply it advantageously to whatever has to be heated, and here I regret to say difficulties often present themselves. It is one thing to have a combustible gas, but quite another to find suitable apparatus to be heated with it. Take for instance the case of a circulating boiler for heating a building—there is not one suitable for gas. There are a few very ingenious little boilers for heating a small quantity of water, but as it would be too costly to heat a large one with town gas there has hitherto been no inducement for boiler-makers to trouble about a large size. In fact, the pioneer of gaseous fuel not only has to provide the gas, but in most cases he has also to devise the means of using it for the different purposes required. I have often been asked if generator or water gas can be used economically for heating ordinary steam boilers, and I have always felt obliged to answer in the negative. I have seen examples of nearly all the water gas plants used in the United States and elsewhere, and I am aware that several attempts have been made to heat boilers with gas of this kind, but so far as my knowledge goes none of them have been successful from an economical point of view. In the first place, if the flames come in contact with the comparatively cool surface of the boiler, there is such a rapid withdrawal of heat that some of the gas does not attain the temperature necessary for its combustion. In the next place there is no overlooking the fact that there must be a considerable loss of heat when the incandescent mass of fuel is enclosed in a gas generator, away from the boiler, instead of being on a grate within, or immediately under the boiler. I venture to think that the true solution of this important question is to be found in the production of gas within the boiler itself, and not in a separate apparatus. The mass of incandescent fuel would then assist by conduction and radiation in heating the boiler.

Reviewing the subject generally, I think it will be admitted that if the progress made has not been rapid, it has at least been sure, and, judging by experience gained in several countries, I find that more attention is given to gaseous fuel every year. It is a subject, too, that is now much better understood technically than it was only a few years ago, and my belief is that every year will see gas more largely used. Speaking more particularly of my own contribution to the subject, it is only right that I should acknowledge my indebtedness for the encouragement I met with when I read my first paper on the subject in 1881. It has often occurred to me since that my own experience in this respect may be taken as a fair illustration of one of the practical advantages of the British Association meetings to a beginner, whose success must depend to a great extent on the help he derives from useful criticism and advice.

THE VOLCANIC ERUPTION IN JAPAN.

THROUGH the courtesy of the editor of the *Pall Mall Gazette* we are enabled to give our readers an account of this catastrophe, together with some illustrations of its effects. The correspondent of that paper writes:—

On the morning of the 16th instant the appalling news reached Tokyo that an enormous volcano had exploded somewhere in the north of Japan, killing and wounding a thousand people. Japan is the earthquake country of the world, but familiarity with cataclysms, as experience has shown, breeds anything but contempt, the moral effect of them being cumulative rather than diminishing; and this news was received with something like consternation, as possibly foreshadowing a general renascence of volcanic activity. The outbreak had occurred in a group of three mountains, in a remote part of the interior, forming part of the great volcanic ridge running north and south through the country, the chief of them being Bandai-san, situated on the shore of Lake Inawashiro, in the province of Iwashiro, in the perfecture of Ken of Fukushima, about two hundred miles north of Tokyo and midway between sea and sea. Besides the difficulty of obtaining accurate information, such an event is among the very rarest experiences of life, and a party was hastily formed to visit the scenes of the catastrophe. We left at daylight the next morning, and before we came back we had seen things to dwarf the most extravagant visions of a disordered imagination, and the mere memory of which is enough to render the solid earth unreal beneath one's feet. To attempt to describe them is to try to draw upon the heavens with one's pen.

One of the excellent lines of railway in Japan runs from Ueno, on the outskirts of Tokyo, nearly due north for 224 miles, passing through the province of Fukushima. Nine hours in the narrow-gauge cars, which are midway between the English and American models in their construction, brought us to the little town of Motomiya, which was the limit of the itinerary we had been able to determine upon before leaving Tokyo. From here we set out next morning for a ride of about thirty miles in jinrikishas to the village of Inawashiro, from which Bandai-san could be reached on foot or on horseback.

From the village of Iwanimura, which we reached at eight o'clock, every mile took us uphill and the landscape rapidly became more broken and rugged, until in two hours' time, when we ran into the village of Takatama, the country resembled the rolling foothills of the Rocky Mountains, except that instead of being bare and brown it was covered to the hill-tops with brilliant verdure. Here we received our first information of the eruption. A terrible noise, the people said, had reached them, lasting nearly an hour, and they had all deserted the village and fled, expecting to be overwhelmed. But the noise was all, and by and by they returned. At Takatama we were nearly half way to Inawashiro. Here the peasants were engaged in the culture of silk; hundreds of flat mat-baskets filled with bushels of cocoons lay about the houses, and through every door we caught a glimpse of men and women reeling the silk thread upon primitive wooden spinning wheels.

The road had now become very bad and hilly. Soon our men stopped at the foot of a broken ascent and pointing upwards told us that there was a short cut for us, while they must go round by the road. The climb was several hundred yards at an angle of forty-five degrees, by the side of a cascade which poured out of a round hole a few yards from the top. When we reached the top we found that this was fed from an irrigating canal four or five miles long from Lake Inawashiro, excellently built and bridged with stone and provided with admirable modern sluice-gates. That the remote parts of the country should thus contain public works of first-class engineering reflects great credit on the Japanese authorities. At our next halting-place, the village of Yamagatta, on the shore of Lake Inawashiro, the dark group around Bandai-san lowered more distinctly in sight to our right; and an obliging Japanese official, already on his way back from the scene, drew plan after plan of the catastrophe for us with his pen and little box of water-colours, as deftly and rapidly as only a Japanese can. At four o'clock we left him and pushed on round the lake, over a road so bad that it was constantly necessary to walk, until at last it degenerated into a mere path among the narrow paddy-fields.

On reaching Inawashiro at last, at the farther end ot the lane, we found that accommodation, not palatial perhaps, as the village is a small and poor one, but much the best to be had, was provided for us.

THE EDGE OF THE PRECIPICE.

The village of Inawashiro, from which we started next morning, is situated at the base of the volcano opposite to that on which the violence of the eruption expended itself, and therefore it escaped injury. It was up this uninjured side of the mountain that we proposed to ascend, and for the first five miles our road was smooth and shaded, leading us through pleasant ascents and between cultivated fields. Then we struck off into the short green scrub, and three miles of this, along a narrow track used by the peasants when cutting fodder for their horses, brought us to the beginning of the ascent proper. The climb now became really fatiguing; it was so steep that an alpenstock was almost necessary, and occasionally hands had to come to the rescue of feet; the path wound in and out round trees and over torrents and stones; recent rains had made it slippery with mud, and all the while a tropical sun was beating straight down upon our heads.

THE BRINK OF THE CRATER.

For an hour and a half, too, there were no more signs of a volcano than there are in Kent or the Catskills; then suddenly our leaders stopped short. We looked about us; there was a smell of sulphur in the air; the leaves at our side were coated with impalpable grey ashes; and there, within a few steps, was a small crater twenty feet wide, a conical hole blown out as though a hundred pound shell had exploded underground. The first burst had of course exhausted the slight volcanic energy at this point, and the bottom of the craterkin was entirely closed. Curiously enough, too, the explosion had been in a lateral direction, trees and shrubs having been blown away, and those left half buried in mud, while a fine tree directly over head was not only uninjured, but not even bespattered. It was only a small affair, but it was our first sight of the actual operation of the volcanic forces of nature, the most mysterious and dreadful forces that man knows, and a thrill ran through us as we stood around the mud hole.

Then we resumed our climb and half a mile more brought us to the midst of the volcanic activity. In every direction were crater-like holes of different sizes; the trees had been twisted off, and split and buried and hurled about; five or six inches of sticky grey mud covered everything; we sank ankle-deep in it at every step, and every now and then, as we still climbed, one of the party would struggle back as he found himself sinking deeper, and shout a warning to the rest to avoid the dangerous spot. Pools of dark yellow sulphurous water, small lakes some of them, had been formed wherever the soil was flat enough for water to rest, and of all the bright turf and foliage which had beautified the spot a few days before, not a single blade or square inch of green was left. It would be impossible—so, at least, we thought then—to imagine a more complete picture of utter desolation than this grey and stinking wilderness, all the more terrible that the form of landscape was vaguely preserved in it, just as a mutilated corpse is the more horrible because it cannot mask entirely the graciousness of the living body. Silently and laboriously, panting and perspiring, we plod upwards, watching every heavy step. We are in single file, a guide leading, and I am third in the line. Surely we cannot get much higher, for the mountain seems to end abruptly just above us. The guide is on the top, the man behind him struggles up, seeking a place for his feet. Then, as he raises his head, his body being half above the edge, he stops short like a man shot, and slowly and in an awe-stricken tone the words fall from his lips—"Good God!" Those of us below shout to him to pass on, and in irresistible excitement and curiosity we scramble up anyhow.

We found ourselves standing upon the ragged edge of what was left of the mountain of Bandai-san, after two-thirds of it, including of course the summit, had been literally blown away and spread over the face of the country. Or, to employ the terminology of geometry, the original cone of the mountain had been truncated at an acute angle to its axis, and we were standing upon the flattened apex of the resulting cone. It must be borne in mind, of course, that we had of necessity approached the focus of the eruption from behind, the volcanic energy having exerted itself laterally and not vertically. From our very feet a precipitous mud slope fell away for half a mile or more till it reached the level: at our right, still below us, rose a mud wall a mile long, also sloping down to the level, and behind it was evidently the crater, for great clouds and gusts of steam were pouring over it; beneath us on our left was a little table-land of mud, on which a few pools had formed. But before us, for five miles in a straight line, and on each side nearly as far, was a sea of congealed mud, broken up into ripples and waves and great billows, and bearing upon its bosom, like monstrous ships becalmed upon the fantastic ocean of some cyclopean nightmare, a thousand huge boulders, weighing many hundred of tons apiece. The sunlight was reflected in weird tints from the pools and lakes; one larger lake was all that was left of a river buried at a blow; where the mud had been coated with ashes it was of a dull grey tint, elsewhere in spots it was dark red; on one side of this awful expanse, a couple of miles away from us, a stretch of bright green meadows sparkled in the sun; on the other a dark pine forest showed how the sea of mud had rolled up to its foot and actually stopped there, almost touching the trunks of the trees; and straight in front of us, five miles away, we could just discern an exit into a long green valley behind which again rose the mountains, range upon range.

(To be continued.)

MUSEUMS AND THEIR ARRANGEMENT.

OUR contemporary, *Humboldt*, gives a very interesting summary of a memoir on this subject by F. W. Haacke. Leaving on one side collections of artificial products, he distinguishes four orders of true museums, in each of which he proposes a separation of the collections for scientific research from those intended for popular instruction. The popular department would consist of two main divisions. The first of these divisions would show the composition of the individual animal, of subordinate elements, cells, tissues, organs, and systems of organs. Where natural preparations are not to be had, their place must be supplied by drawings and models. Here also come collections illustrative of anatomy and ontogeny. Then would follow the faunæ of a meadow, a forest, a pool, the inmates of an oyster-bank, a bed of sea-weed, or a coral reef.

The second main division is made up of the systematic geographical and palæontological collections. The systematic collection gives a general view of the forms of the animal world in genera and families. The geographical collection should show the characteristic fauna of each main region, as described in Wallace's "Geographical Distribution of Animals." The palæontological division would show the fauna of each successive geological formation.

We may here pause and ask how many museums are there in the world which place at the disposal even of the professed naturalist, a system of collections such as Haacke hopes to display to the general public?

Haacke rightly insists that presents which are not in harmony with the purpose of the museum should be declined, as they take up room, of which there is always a deficiency, and involve useless work. A friend of ours, in visiting a provincial museum, was once most unpleasantly struck at seeing in a glass-case a pair of breeches which had been worn by a foreign nobleman who at one time resided in the district!

The four orders of museums are such as respectively embrace the products of the world, of an empire, a province, or a parish.

General Notes.

Sanitary Precautions in France.—The Consultative Committee of Public Health in France (*Cosmos*) has interdicted the use of benzoic acid as well as that of salicylic acid as an antiseptic addition to articles of food and drink. The committee has also decided against alloys of lead for capsuling bottles.

Volcanic Eruptions.—Advices from the Philippine Islands, *via* Hongkong and Yokohama, received at Queenstown on Saturday morning, state that over 300 lives were lost in those islands by the eruption of an old volcano, named Mayon, at the latter end of July. Several hundreds of houses were also destroyed by the lava and ashes, and the natives were in a state of panic. Volcanoes in the islands of the Bissayar group were also in a violent state of eruption, and it is thought there has been a terrible loss of life. The news was brought to Queenstown from New York by the *Umbria*.

Eruption of Stromboli.—Captain Hammond, of the steamship *Duchess of Sunderland*, reports that on the 12th inst., while on a voyage to Venice, he noticed that the volcano Stromboli was in a state of eruption. Ordinarily nothing but thin vapour is observed to proceed from the mountain, but on this occasion a huge flame eclipsed the stars. At an altitude of 7 deg. the upper portion of the flame burst into countless glowing particles. The deck of the steamer was covered with dust, and the steamer was enveloped in dusty cloud for a distance of ten miles.

Ascent of Mount Elburz.—On the 25th ult. the ascent of Mount Elburz was successfully made from the eastern side by Baron Ungern Sternberg. In notifying the event to the Tiflis Geographical Society, the Baron wrote:—"We set out at 11, and crossed the glaciers Iriktchat, Atrium, and Djelkaoughenkes, hitherto deemed impassable. At an altitude of 15,200 feet I discovered an enormous crater. We passed three nights on the mountain at the different heights of 9,000, 14,760, and 17,840 feet. At the last height we passed through a terrific snowstorm. Breathing was not attended with any great difficulty. The health of my men has been good. I descended by the southern side between Azaou and the Terek."

Discovery of Nuggets in Australia.—The *Melbourne Argus* states that a nugget, weighing 386 ozs., and estimated to yield 375 ozs. of pure gold, was, on July 23rd, discovered in the workings of the Burnt Creek Company, Dunolly. This is the largest nugget found since July, 1887, when one weighing 617 ozs. was unearthed in the Midas claim. Two months previously a nugget 169 ozs. in weight was discovered in the ground of the same Company. These are the three largest nuggets found in the colony since August, 1880, when one weighing 330 ozs. was found in Shicer's Gully, Wedderburn. A report was also received by the Secretary for Mines (Mr. C. W. Langtree) that a party of miners at Wedderburn, at 6 ins. below the surface, had dug up a nugget 44 ozs. in weight.

The Krakatoa Eruption.—The report of the Committee of the Royal Society appointed to inquire into the history of the great Krakatoa eruption is now in the press. It will contain an account of the volcanic phenomena of the eruption, and an essay on the nature and distribution of the ejected materials, by Professor Judd; papers on the air waves and seismic sea waves caused by the eruption, which, it will be remembered, was the most tremendous instance known in modern times. The general public will be most interested, however, in the report of the evidence collected from all quarters of the globe on the unusual optical phenomena of the atmosphere observed in 1883-86, including twilight effects, sky-haze, coloured suns, and coronal appearances, supposed to have been due to the presence of Krakatoa volcanic dust floating in the upper regions of the air.

Japanese Lacquer for Iron Ships.—The Japanese Admiralty has finally decided upon coating the bottoms of all their ships with a material closely akin to the lacquer to which we are so much accustomed as a specialty of Japanese furniture work. Although the preparation differs from that somewhat commonly known as Japanese lacquer, the base of it is the same, viz., gum lac, as it is commonly termed. Experiments, which have been long continued by the Imperial Naval Department, have resulted in affording proof that the new coating material remains fully efficient for three years, and the report on the subject demonstrates that, although the first cost of the material is three times the amount of that hitherto employed, the number of dockings required will be reduced by its use to the proportion of one to six. A vessel of the Russian Pacific fleet has already been coated with the new preparation, which, the authorities say, completely withstands the fouling influences so common in tropical waters. It occupied the native inventor for many years to overcome the tendency of the lac to harden and crack, but having successfully accomplished this, the finely polished surface of the mixture resists in an almost perfect degree the liability of barnacles or weeds to grow, while presumably the same high polish must materially reduce the skin friction which is so important an element affecting the speed of iron ships. The dealers in gum lac express the fear lest the demand likely to follow on this novel application of it may rapidly exhaust existing sources of supply.—*Scientific American*.

The International Meteorological Committee.—This committee held a meeting at Zurich, in the Polytechnikum, from the 3rd to the 5th of this month. The most important point on which action was taken was the subject of future meetings to be held instead of Meteorological Congresses organised by diplomatic means. The following resolution was adopted:—"The committee, in view of the circumstance that the assembling of an international meeting, of the same character as the congresses of Vienna and Rome, presents great difficulties, considers that the commission it received at Rome is exhausted, and that it ought to dissolve itself. At the same time, in order to continue the relations between the different meteorological organisations, which have been productive of such good results during a series of years, the committee appoints a small bureau, with the duty of using its best endeavours to bring about, at some convenient time, an international meeting of representatives of the different meteorological services." By a subsequent resolution the bureau was made to consist of the President and Secretary of the committee (Professor Wild and Mr. Scott). Among other matters on which action was taken may be mentioned Cloud

Classification. It was decided that the proposals of Messrs. Hildebrandsson and Abercromby were not ripe enough to be recommended for general adoption. Meteorological Information from Travellers.—On the motion of Dr. Hann, certain rules were laid down, to be recommended to all geographical societies, etc., as to the conditions which must be observed in order to render published records of meteorological observations of any real service to meteorology. These relate to instruments and their corrections, exposure, methods of calculations, etc.

Electrical Phenomenon.—A curious electrical phenomenon observed from the Danish steamer *Constantin* in the North Sea in February last, and its effect upon the vessel's compass, has been the subject of research by a Danish physicist, Herr Neergaard, from which we gather the following:—On February 10th, at 5.30 a.m., when 160 geographical miles off the Tyne, and steering E. ½ N., the weather being cloudy and variable with alternate calms and strong gusts of wind, the officers on watch observed two great clouds, whence flashes of lightning proceeded from time to time, approach each other, one coming from the N.E. and the other from S.W. Presently the clouds commingled, when a terrible clap of thunder rent the air, and a shock was felt on board the vessel so severe that all those on their legs below and on deck were thrown down, whilst the captain rushed on deck thinking that a collision had occurred. Simultaneously the vessel seemed to float in a sea of red fire and enveloped in red flames, whilst all protruding objects on board became tipped with a brilliant light. In a couple of minutes the red sheen disappeared, but for a long while afterward a strong smell of sulphur was experienced on board. The vessel was at the time steering straight on the clouds in question, and must have received the terrible electrical discharge full on the stem. However, all went well till the Scaw was reached, when it was found that through the phenomenon the ship's compass showed a deviation of 1 deg., but when approaching Copenhagen on the following day it was discovered that the deviation had really been altered from 6·5 degs. west to 3 degs. east. It is needless to point out the serious consequences such a deviation would undoubtedly have entailed at night.

The Public Health.—The Registrar-General's return for the week ending September 15th shows that the deaths registered during that period in 28 great towns of England and Wales corresponded to an annual rate of 17·7 per 1,000 of their aggregate population, which is estimated at 9,398,273 persons in the middle of this year. The 6 healthiest places were Oldham, Wolverhampton, Leicester, Hull, Sunderland, and Bristol. In London, 2,488 births and 1,331 deaths were registered. Allowance made for increase of population, the births were 217, and the deaths 77, below the average numbers in the corresponding weeks of the last 10 years. The annual death-rate per 1,000 from all causes, which had been 17·5, 16 4, and 16·0 in the three preceding weeks, rose again last week to 16·2. During the 11 weeks ending on Saturday last the death-rate averaged 16·2 per 1,000, and was 3·8 below the mean rate in the corresponding periods of the ten years 1878-87. The 1,331 deaths included 27 from measles, 24 from scarlet fever, 18 from diphtheria, 31 from whooping-cough, 12 from enteric fever, 1 from ill-defined form of continued fever, 122 from diarrhœa and dysentery, and 1 from choleraic diarrhœa; thus 236 deaths were referred to these diseases, being 19 below the corrected average weekly number. No death from small-pox was registered, the corrected average being 6; no small-pox patients were under treatment in the Metropolitan Asylum Hospitals, and only 1 in the Highgate Smallpox Hospital, on Saturday last. In Greater London, 3,285 births and 1,671 deaths were registered, corresponding to annual rates of 31·0 and 15·8 per 1,000 of the estimated population. In the Outer Ring 34 deaths from diarrhœa, seven from diphtheria, and five from "fever" were registered. Of the fatal cases of diarrhœa, 8 occurred in West Ham, and 3 in Richmond sub-districts. The 7 deaths from diphtheria included 2 in Croydon sub-district.

The Faro of Maracaibo.—Something like an intelligible explanation of the singular phenomenon which has been known since the conquest of South America as the Faro of Maracaibo is volunteered by Consul Plumacher in a recent report from that interesting quarter of the globe. The phenomenon consists of constant lightning without thunder, which has been observed from time to time by travellers, southwards from the bar at the entrance of the lake. Several theories have been put forward to explain the strange occurrence, and Codazzi, in his geography, supposes it to be caused by the vapours arising from the hot water swamps, situated about a league to the east of the mouth of the Escalante river, at the southern extremity of the lake. Consul Plumacher, however, ascribes the Faro to the immense amount of inflammable gas given off by the flows and deposits of petroleum. Writing on the information of some explorers who have visited the place in search of *balsam copaibo*, and who call it the *Infernito*, or little hell, the consul furnishes a description of this unknown but exceedingly rich region. A very large portion of the department of Colon, situated between the rivers Santa Anna, Zulia, and the Sierra of the Columbian frontier, is an uninhabited forest, very rich in asphalte and petroleum. Near the Rio de Oro, at the foot of the Sierra, there is a very curious phenomenon, consisting of a horizontal cave, which constantly ejects, in the form of large globules, a thick bitumen. These globules explode at the mouth of the cave with a noise sufficient to be heard at a considerable distance, and the bitumen, forming a slow current, falls finally into a large deposit of the same substance near the river bank. At a distance of little more than four miles from the confluence of the rivers Tara and Sardinete there is a mound of sand, from twenty-five to thirty feet in height, with an area of about 8,000 square feet. On its surface are a multitude of cylindrical holes of different sizes, which eject streams of hot water and petroleum with great violence, causing a noise equal to that produced by two or three steamers blowing off simultaneously. For a long distance from the site of this phenomenon the ground is covered or impregnated with petroleum, and it is stated that from one only of these streams of petroleum a receptacle of the capacity of four gallons was filled in one minute. For one hour this would give a flow of 240 gallons, or 5,760 gallons in twenty-four hours. It is from this discharge that the gas, which Consul Plumacher considers to be the origin of the Faro of Maracaibo, issues.

SURFACE TENSION.

(*Continued from p.* 314.)

HITHERTO we have operated only on masses of liquid relatively considerable, and having only one free surface. We may now mention new instances of tension furnished by small masses having two surfaces in contact with the air and capable of producing effects of a much more striking character.

Fifth Experiment.—We take a litre of water in which have been dissolved twenty-five grammes of curd-soap and the same weight of sugar-candy. We plunge into it a wire frame, and then withdraw it. We find it occupied by a flat plate which seems to be without weight, so little is it bent. As it becomes attenuated, the contractile force of the two surfaces predominates more and more. Let us place upon this plate a closed outline of cotton or silk thread. It may take any form, because there is a liquid film both within and without. But as soon as we burst the interior film the thread becomes perfectly circular (fig. 5). This is the effect of the combined tensions of the two surfaces of the remaining film. The thread takes the form for which the surface which it bounds is as great as the length of the thread permits, that is, a circle.

Sixth Experiment.—My assistant, Professor Schoentjes, has endeavoured to modify this experiment, which I published in 1866. He takes not a simple thread, but a system composed of solid rectilinear portions, and portions of arbitrary form; according to Steiner's theorem, the maximum surface bounded by such an outline is found when all the portions of arbitrary forms are arcs of one and the same circumference of which the solid rectilinear portions constitute so many chords.

Prof. Schoentjes has realised such systems by means of cocoon threads passed into the small free channels of portions of the stems of fine graminaceous plants. Each time Steiner's theorem has been perfectly verified when one of these systems has been placed upon a plane liquid film, and the inner portion has then been burst. (fig. 5.)

The foregoing experiments have been made each with a single liquid. But it may be foreseen that if we bring in contact two liquids of different tensions there will be produced centripetal or centrifugal movements, according to the value of these tensions.

If the two liquids mix like water and alcohol, the tension of the surface of contact is null. Hence if we place upon water a drop of alcohol (2·5) or of ether (1·88), we observe a violent movement of extension, because the tension of water (7·5) greatly exceeds that of alcohol (2·5), or that of ether (1·88). After this spreading out the liquid retreats towards the point where it has been deposited. It is because the evaporation of the alcohol or the ether has cooled the subjacent liquid, which has thus a stronger tension than that of the more distant parts.

When the two liquids brought into contact do not mix, as, for instance, oil and water, the surface common to these liquids has also a tension which cannot be neglected.

If we place a drop of oil of turpentine (2·90), of oil of lavender (3·0?), etc., upon pure water contained in a large vessel, we observe at once a rapid diffusion of the drop, which is transformed into a very thin film, often presenting the most beautiful colours. This diffusion is due to the fact that the tension of pure water (7·5) is greater than the sum of the tensions of the oil and of the surface common to the two liquids.

As this rapid extension is accompanied by a fall of the temperature of the original drop, the film does not retain its form, but is subdivided into an infinity of very minute portions, forming sometimes small curvilinear polygons, and recalling the aspect of fine lace; this is what Mr. Tomlinson has called a "cohesion-figure." With oil of lavender the figure is soon broken up into a multitude of spots scarcely visible.

The application of one drop or of two drops of oil upon water is generally sufficient to render the extension of a new drop impossible. This is because the surface tension has become equal or inferior to the sum of the tensions of the oil and of the surface common to the two liquids.

Since 1869 I studied this kind of phenomena very carefully, though Signor Marangoni, of Florence, had,

FIG. 5.

unknown to me, already given the explanation. If, upon the surface of pure water, we deposit a small fragment of a solid body which is more or less soluble, the equilibrium of the surface of the water is destroyed, and if the act of solution takes place unequally on different sides of the fragment the latter presents abrupt movements of translation and of rotation.

Let us place, for instance, upon distilled water a flexible, closed outline (of thread), 25 or 30 centimetres in length, so that it touches the water on all its lower side without being submerged at any point. Let us then drop upon the surface of the water within the enclosure one or more small fragments of camphor. Immediately the fragments begin to rotate briskly, and to change their place, and the thread will arrange itself in a perfect circle. The interior liquid sometimes passes over the flexible outline at one or more points, when the entire circular film moves on the surface of the liquid. All these phenomena are due to the unequal distribution of the camphorated water, the tension of which is 4·5 milligrammes.

As regards the diffusion of oil upon water, I may be permitted here to mention an important application which I pointed out in 1882. Let us remember that per millimetre of length the surface of water experiences a tension of 7·5 milligrammes. Let us imagine a surface of water of one square millimetre, and ask what work must be expended in order to double this surface of one square millimetre. We have to overcome a series of small forces the sum of which is 7·5 milligrammes, and to cause all the points of application of these elementary forces to describe a track equal to one millimetre. But as the work is exactly equivalent to the product of the intensity of the force of the track traversed upon the right line where the force exists we have to effect here a work of 7·5 milligrammes-millimetres. This work expended will be found as available energy in the new square millimetre of free surface; it is this energy of 7·5 milligrammes-millimetres which I have called the potential energy of pure water. We must not forget that this energy resides in a layer of not more than $\frac{1}{20,000}$ millimetre in thickness. We thus comprehend than in the surface layer of the ocean there is stored up a mechanical power, of which nothing can give an exact idea.

I suppose now that of two surface layers, equal and in juxtaposition, the one glides over the other by the action of the wind. The layer which is completely covered, will have lost its free surface, and with it its characteristic potential energy. If the sliding is effected slowly, this energy will be replaced by an equivalent quantity of heat. But if the phenomenon takes place rapidly the lost potential energy gives rise to an increase of speed. If, therefore, the wind communicates to certain layers of the sea a greater velocity than it does to the neighbouring layers, the latter are covered by the former which in turn cover others more remote, and so on. This is why each wave in the course of formation is composed of portions whose velocities are greatest towards the top. When the wind is violent the acceleration of velocity produces upon each wave a crest which becomes more and more prominent, and which finally *breaks*.

Hence it follows that any cause which prevents the sliding of superficial layers of the waters of the sea one over the other, will constitute an obstacle to the gradual increase of the *vis viva* of the liquid masses.

But just such a cause is found in oil which covers the surface of the sea over a sufficient extent; in virtue of its low specific gravity it always rises to the surface and renders the sliding of one layer over the other impossible. This explains the seemingly mysterious efficacy of oils capable of being spread out in films of an incredible thinness (1-100,000 to 1-200,000 of a millimetre). As soon as this sliding of the layers is prevented the formation of the breakers so dreaded by ships is rendered impossible.

Further, this action of oils transforms crested waves into an even swell, as was pointed out even by Aristoteles, Pliny, and Plutarch.

The author, Professor Van der Mensbrugghe concludes his memoir with regretting that the use of oil at sea is not studied in Belgium.

EXPLORATION IN MOROCCO.

FROM communications received from Mr. Thomson, dated from the city of Morocco, July 22nd, it appears that by a series of surprises and cleverly-planned excursions he has been able to enter the mountain fastnesses of Morocco and do more than any previous traveller has done. From Demnat he made two extremely interesting trips into the lower ranges, visiting some remarkable caves and equally remarkable ruins, and one of the most wonderful natural bridge-aqueducts in the world. Geologically and geographically these trips are alike important. This was followed by a dart across the main axis of the Atlas to the district of Tiluit, which lies in the basin of the Draa. As the tribes further west on the southern slope were in revolt, Mr. Thomson was compelled to return to the northern plains. Starting once more, he crossed the mountains by a pass a little south of Jebel Tizah, ascended by Hooker, and reached Gindafy safely. He was able to make a trip up a wonderful cañon, which he declares rivals those of America for depth and grandeur, and ascended a mountain, where he and his party were confined to their tents until it suited them to go back to their starting point. Here Mr. Thomson's companion, Mr. Crichton Browne, was stung by a scorpion, and they were compelled to return by a new route.

From his previous starting point Mr. Thomson scored another great triumph. He crossed the mountains once more, and ascended with no small danger and difficulty the highest peak of the Atlas range north of Amsiviz, a height of 12,500—the highest peak by 1,500 ft. ever attained.

In a few days after the date of his letter Mr. Thomson intended to resume work. He proposed to make for the Urika river and penetrate the mountains up its course, then work his way round to Mogador, which he expects to reach about the end of August. He may then make one or two short trips into the interior and down to Agadir. The return route to Tangier will probably be from Mogador to the city of Morocco, thence to Mazagan on the coast, and on to Casablanca and Rabat. Then he will leave the sea again and go to Mequinez and Fez, reaching Tangier about the end of the year.

NOTES ON ESSENTIAL OILS.

HOP oil, distilled from Bavarian hops, has now displaced that prepared from lupulin, which it excels in richness and delicacy of odour, due to the absence of butyric and valerianic acids. It is a mistaken notion that this oil has narcotic properties.

Marjoram oil, from Spain, recently introduced into commerce, differs essentially from the oil distilled from German marjoram. It is recognized by its freedom from colour.

Pepper oil, used extensively in fortifying spices, is obtained as a by-product in the manufacture of piperonal (heliotropin).

Rose oil and rose water have been recently produced in limited quantities experimentally in Germany, near Leipsic. It is said that there are now under cultivation for this purpose 15 acres of land, and the results have been quite satisfactory. The German oil is superior to any imported. It congeals at 20° (68° F.), showing the presence of a larger proportion of the fragrant stearoptene than is contained in the best Turkish oil.

Betel leaves yield an essential oil (0·5 per cent.) of a brown colour, an agreeable, tea-like odour, and a burning taste. Its specific gravity is 1·020 at 15° C. It boils at 250° to 260° C., and consists of a phenol agreeing in properties and reactions with eugenol and an indifferent hydrocarbon. The leaves are used in India in catarrhal and pulmonary affections, and it is probable that they owe whatever therapeutic virtue they have to the essential oil.

Natural History.

THE PROTOPTERI AT THE MUSEUM OF NATURAL HISTORY, PARIS.

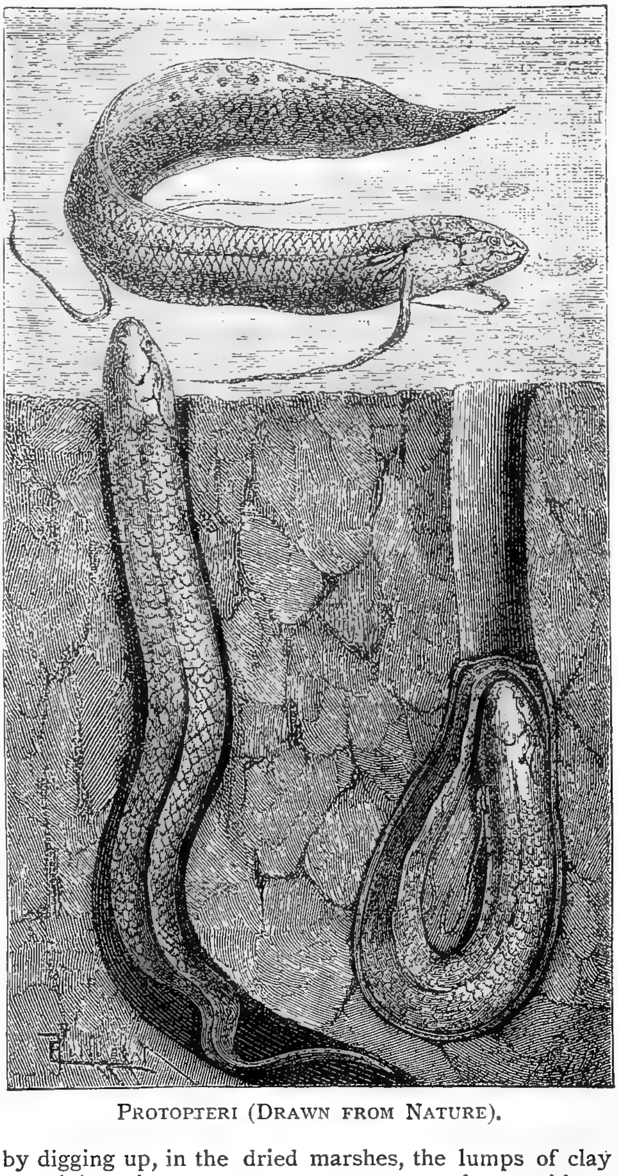
THANKS to the efforts of Professor Heckel, of the Faculty of Sciences at Marseilles (who must not be confounded with Professor Haeckel of Jena), the menagerie of the Museum of Natural History has just received a most curious fish, the *Protopterus annectens* (Owen), a creature the singularity of whose habits and the ambiguity of whose organisation have attracted the attention of zoologists for more than half a century.

The aspect of these worm-like creatures reminds us, to a certain extent, of that of an eel. They are covered with very distinct scales, and instead of symmetrical limbs they possess merely a sort of filaments fringed upon one of their margins. Of these filaments they make use rather awkwardly, sometimes when they float in the water letting them droop on each side of the body and sometimes giving them an undulatory motion apparently at hazard. According to our present knowledge there exists one only species of this genus, but it is widely distributed throughout tropical Africa from the Senegal to the coast of Mozambique and from the Upper Nile to the Ogoone. Those in the Museum are from the Gambia.

The habits of this fish have not yet been studied in full detail, though what we know is sufficient to excite curiosity. They inhabit the margins of great rivers, and especially the marshes formed by the periodical inundations in the rainy season. At this time the *Protopteri* lead an active life, swimming along the muddy bottom and feeding on small aquatic animals, or biting off, with their strong and scissors-like jaws, pieces of flesh from larger prey which they may seize. But the conditions of existence are soon greatly modified. The dry season sets in and the heat of the sun dries up the marshes. The animal knows very well how to accommodate itself to the novel situation. Knowing that the water will soon be deficient it excavates in the mud a cylindrical hole of a depth proportionate to its size, so that when coiled up laterally and the tail placed over its snout the latter may still be from ten to twenty centimetres from the entrance of the hole (fig. 1). There appears at the same time over the surface of its body a mucous exudation which hardens and forms a solid case, not easily penetrable in fact, a true cocoon. In this the *Protopterus* patiently awaits the return of better days.

The arrangement of the cocoon seems to indicate that it does not result from a simple cutaneous secretion, in which case it ought to produce a covering, having more or less exactly the regularly ovoid, elongated form taken by the fish. On the contrary, it represents a kind of bottle with a hemispherical end below, whilst the opposite extremity, turned towards the mouth of the hole, is covered with a circular lid, marked of from the rest of the cocoon by a very well-defined line of junction. This structure may perhaps be explained by a direct action of the fish, which elaborates its covering intentionally in a definite form, analogous to the procedure of certain insects. Still, it seems more probable that the result is purely mechanical. The mucous secretion forms at first a homogeneous case which adheres strongly to the mud wherever it comes in direct contact. Still, the upper extremity remains free. We comprehend that at the moment of desiccation the sides and the bottom will be kept in their place by this natural adherence whilst the free part will stretch, as does parchment if applied whilst moist to the mouth of a vessel, and will finally form a flat portion as if superadded to the case.

The *Protopterus* when once enclosed may remain dry for a longer or shorter time in a sort of lethargic sleep, comparable to hybernation, until it is set at liberty by the return of the rainy season. It is then very easy



PROTOPTERI (DRAWN FROM NATURE).

by digging up, in the dried marshes, the lumps of clay containing these cocoons to transport them without trouble and without any injury to the animal. Those which are now to be seen at the museum, after remaining six months at the Isle MacCarthy, have still remained dormant for five weeks on their journey to Marseilles and Paris.

This property, singular for a fish, of being able to pass so long a time away from its normal element, was, we might say, explicable even before we knew its abnormal habits. The first type known of the group is the

Lepidosiren, a very near ally of the *Protopterus*, from which it is distinguished by the absence of fringes on its natatory filaments. It inhabits the great rivers of South America, where it was discovered in 1837 by Natterer. Its simultaneous possession of gills and lungs was readily discovered, and the question arose whether this strange vertebrate was to be referred to the Batrachians or the fishes. Natterer, Bischoff, Milne-Edwards, Vogt, and Duvernay placed this animal in the former group, whilst Owen, Muller, Agassiz, and Peters referred it to the second.

Although this latter view is now generally accepted, we must admit that these ambiguous beings form between the two classes an intimate connecting link, well adapted to show us how artificial are our systematic classifications. It is easy to understand how, by means of this double breathing apparatus (whence the name of *Dipnoi* is given to the group) the *Protopterus*, as it may happen to require, may either use its gills or breathe air, being thus amphibious in the absolute sense of the word.

To induce these animals to resume their active life, we plunged the lumps of clay into water. The result was favourable; the next morning the survivors, about half of the lot, had abandoned their cells and were swimming freely in the aquarium.

One of them makes an exception. Since its immersion, three weeks ago, it refuses to quit entirely its tube. It is, however, full of life, for its head appears almost always at the aperture, but at the least alarm it hides itself with great rapidity.

Although this one alone has thus remained in this position, M. Leon Vaillant, from whose memoir in *La Nature* the above facts are borrowed, is led to believe that it shows us the normal habits of these animals. When they are observed swimming by means of the undulatory movements of their bodies they proceed with difficulty, and their long filamentous fins seem more embarrassing than useful. On the ground they make use of these organs to feel at surrounding bodies, lumps of clay, stones, etc., among which they glide along with a certain agility, after the manner of serpents or eels. On the other hand, being better adapted for attack than defence, in our aquariums they are often mutilated by their companions, who snatch away portions of their tail, skin, etc.—losses which are quickly reproduced. Perhaps the one which remains inside its tube is the most judicious, and may, like certain lower animals, lurk in its cell and snatch at any passing body.

The size which the *Protopteri* reach in their native rivers is considerable. M. de Brazza has found them above a yard in length and of the thickness of a man's arm. The largest of those in the menagerie does not exceed half-a-yard.

Whether analogous facts may be observed in the other Dipnoi is uncertain, especially whether they can use their double respiration and encase themselves. With the Lepidosiren the anatomical structure and the outer appearance speak in favour of this supposition, though we have no positive proof. With the *Ceratodus* of Queensland the matter is less probable as its lungs are very imperfect.

A New Parasite.—Professor Baelz (*La Nature*), of the University of Tokio, has detected, in the liver of some of the native Japanese, parasitic worms resembling the "flukes" so often found in the livers of sheep. This new species has received the name *Distoma Japonicum*. Its life-history has not yet been studied, but its geographical distribution is most remarkable. It is endemic in the centre of Japan in two very limited regions, where it is a real public calamity. These two regions have a swampy soil, and the inhabitants, who are attacked in the proportion of 20 to 50 per cent., drink an impure and very saline water. In the remainder of Japan this parasite is very rare in man, but it has been found in the liver of cats at Tokio.

Cuckoo Hatching Her Eggs.—The notion that the cuckoo is incapable of incubating, and that she of necessity lays her eggs in the nests of other birds, is incorrect. Herr Müller, forest-superintendent, of Hohenschied, in Germany, makes the following communication on this subject in the *Gartenlaube*:—On May 16th he found in the north-eastern portion of his district a cuckoo sitting on three eggs. Of these one was actually hatched. The bird proved a most attentive mother, feeding her young with small green caterpillars. Herr Müller is known as a careful and accurate observer.

The Origin of the Hottentots.—With reference to the Hottentots now on view at the Jardin d'Acclimatation M. Zaborowski (*La Justice*) maintains that this race is a cross between the Caffre and the Buschman. M. Topinard remarks that the Hottentot men have more of the Caffre character, whilst in the women the Buschman type prevails. The Buschmen pronounce six consonants with a peculiar "click," which no adult European can acquire; the Hottentots click four consonants and the Caffres only three.

A Vaccination Against Cholera.—M. Pasteur has just read to the Academy of Sciences a communication from Dr. Gamaleia, of Odessa, in which the author expresses his confidence that he has discovered a "vaccine" for Asiatic cholera. Having rendered the cholera bacillus intensely morbific by a passage through guinea-pigs, he finds that inoculation with an ordinary non-virulent culture of cholera renders the subject capable of resisting the intensified modification above-mentioned. He finds that this immunity is acquired without danger and without exception.

Action of the Ultra-violet Rays upon the Growth of Plants.—This subject, according to *Humboldt*, has recently been studied by Sachs, who cultivated nasturtiums (*Tropæolum majus*) behind glass vessels filled with a solution of sulphate of quinine, which cuts off the ultra-violet rays. The plants developed their leaves imperfectly, and did not flower. Other plants, grown as a check behind similar vessels, filled with water, grew, and flowered perfectly. Hence it appears that the solar spectrum has three regions differing in their physiological action: the yellow rays, which decompose carbonic acid, and effect assimilation; the blue and violet rays, which effect the mechanical processes of vegetation, in as far as these depend on light; and, lastly, the ultra-violet rays, which effect in the green leaves the formation of those principles which are necessary for the formation of flowers.

Humble Bees in New Zealand.—According to J. W. Dunning (*Transactions of the Entomological Society*), in 1885 about 100 humble bees were sent to New Zealand in two lots, and set free at Lyttleton. By the next summer they had penetrated as far as Timaru, West Coast Road, and Stenmark, and increased to an astonishing degree. The farmers find that their red clover is now exceedingly rich in seed.

Weight of Brain in Small Birds.—In the following following species the weight of the brain in proportion to the body is greatest. In *Regulus calendula* (ruby-crossed kinglet) it is one-seventeenth of the body; in *Parus atricapillus* (chickadee) one-seventeenth, and in *Setophaga ruticilla* (American red-start) one thirteenth.

Insect-eating Plants. — According to Prof. W. P. Wilson (*American Naturalist*), the appliances for the capture of insects are much more efficient in *Sarracenia variolaria* than in the more common *S. purpurea*. He considers that in the latter species the insect-feeding habit is disappearing.

Cure for the Bite of Vipers.—According to the Rev. Henri Dussart, of Saint Omer, a small glass of the juice of the burdock (*Arctium lappa*) taken inwardly effects a cure even in apparently desperate cases.—*Cosmos.*

Extirpation of the Vicuna.—The American Consul Baker (*Humboldt*), in a report to his Government, estimates the number of vicuñas destroyed yearly at a quarter of a million, and fears their early extermination unless protective measures are promptly adopted.

THE KAGU.—II.

(*Continued from page* 316.)

Little is known of the breeding habits of these birds, as up to 1885 not a single nest had ever been found by any reliable authority (although the natives, of course, have theories of their own upon the subject). The Kagus make apparently but little use of their wings, invariably roosting on the ground, with their heads either sunk between their shoulders or tucked under their wings, and although very expert in climbing up the wires of their cage when in captivity, they manifest but little interest in the higher vegetation of their native land, contenting themselves with the stumps and lower branches of the trees, and when alarmed, simply hiding in the brushwood. According to some later English settlers in New Caledonia, the Kagu is a nocturnal bird, a fact which its earlier biographers omitted to chronicle, though they all noticed that it was invariably more lively towards evening. It frequents the banks of rivers, small marshes and ponds, and especially the sea-shore, and it seems to have a great predilection for wet weather and heavy dews. It feeds on snails, worms, etc., seeking its food in all sorts of holes and corners, instead of patiently waiting, like its cousin the Heron, to seize its prey when in motion. It breaks the snail shells on a stone in much the same way as our English thrush. It never touches seeds, vegeables, or bread, even when in captivity, but will eat meat, if cut up small, and will devour worms to an amazing extent. M. Joubert used to employ natives to collect worms for his Kagu, and found that it easily disposed of about a quart per diem. The Kagu is very shy when wild, but once caught, is easily tamed and domesticated, especially if caught young, and it will adapt itself with surprising quickness to the habits of a poultry-yard. At Port de France, New Caledonia, there lived for some time a very tame pair of these birds, which were quite well-known and highly-respected inhabitants of the town. If a dog ever ventured to interfere with them, they would at once raise their crests, and vigorously flap their wings and otherwise show signs of anger until they had driven the intruder away, and they invariably followed workmen with digging implements, showing a quick appreciation of the laws of cause and effect, as demonstrated in the relations between spades and worms. As domestic pets, these birds should be held in high esteem; they are active and agile to a degree, and their pantomimic antics are so absurd that they could not fail to amuse any one at all interested in bird-life. The Kagu has a sort of Mark-Tapley-like faculty of accommodating itself to adverse circumstances, which is worthy of all praise. It presumably prefers liberty, but once captured, instead of idly bemoaming its fate, it briskly sets to work to make the best of a bad bargain, generally inaugurating life under these new aspects, if in company with other birds, by a rousing chase of its companions. It would be unjust to the bird (which, by the way, must be M. Ferdinand Joubert's "Kagu Bush" so-called, since he stigmatises the other member of the family as distinctly pugnacious)—it would be unjust, we repeat, to hastily dub this cheery little being as quarrelsome. He is merely mischievous, and extremely fond of teasing, but all in a good-natured way which seldom provokes the serious anger of even the object of his attacks. To rush with crest erect and wings outspread, at some peaceably-minded fowl, and chase her wildly round the yard, spurring her all the while with little twinges of her tail, seems to afford a Kagu the greatest possible pleasure, while at other times he will play with a piece of paper or dead leaf like the veriest kitten. Sometimes he will thrust his bill into the ground, spread his wings, and kick his yellow legs convulsively in the air, as though in the last agonies of a fit, and when some one, attracted by the unusual sight, hastens to his assistance, he promptly regains his equilibrum, and bowing gravely to the sympathetic spectators, walks off with stately mien and dignified gait as if in silent protest of the whole proceeding. A Kagu finding his breakfast is a decidedly entertaining sight. With his crest down, his wings smooth and sleek, he paces demurely along until he sights a likely spot, where, with becoming solemnity, he proceeds to gently tap the ground until a worm, probably alarmed lest the tapping should herald the approach of a mole, emerges at the surface to escape his underground enemy. Then, hey presto! the crest is jerked up, wings shaken out, and with evident approval the worm is swiftly swallowed. A few little jerks of satisfaction, a general shake of crest and feathers into their former sleekness, and with Puritan-like gravity Mr. Kagu steps daintily off to fresh fields and pastures new. Occasionally these comical birds will lay aside all their antics, and will parade soberly up and down their enclosure, bowing to their companions as they pass with a grace and dignity worthy of Sir Charles Grandeson, and with an air which seems to challenge admiration and defy criticism. All things considered, it it a matter of deep regret that a bird of such "infinite parts" should have been so ruthlessly sacrificed to the gourmands of its native land that it threatens to join the Dodo and the Epiornis in the unhappily steadily-increasing ranks of the extinct species.

DOMESTICITY IN ANIMALS.

THE existence of domestic animals suggests to us some curious questions, to some of which naturalists have not hitherto been able to furnish a rational answer. We may be asked why man has succeeded in taming certain species and not others? Why had the natives of the western hemisphere, when discovered by the Spaniards, practically speaking, no domestic animals at all, whilst nations of the eastern continent, not further advanced in civilization, had enjoyed the services of beasts of burden from the most remote antiquity?

Swainson and his followers cut the knot by asserting that animals of the rasorial type had been Divinely pre-ordained for domestication. These, therefore, man had succeeded in taming, whilst with all other species he has failed.

But if Swainson's "rasorial type" have been especially adapted for domestication, why do so many of them hold aloof? Take as an instance the common pheasant. This bird belongs to the same family as the barn-door fowl. The delicacy of its flesh has tempted man to reduce it to complete domestication, so that it might be bred in the poultry-yard. But no: on the approach of a stranger it shows none of the confidence of the domestic fowl, but flees for shelter to the nearest thicket.

Why did none of the aborigines of America domesticate the turkey? In Europe, as with the white settlers beyond the Atlantic, it has proved quite capable of tameness. Were not the ancient Mexicans civilised enough to have made the attempt?

Why was the American bison (erroneously called buffalo) never brought into subjection by the Red Indians? To them it would have been of great service as a beast of burden as well as for food. Mr. Swainson, to make his escape, pronounces the "ox the typical example of the genus bos, the bison the sub-typical." He adds that "no two animals can be more opposite in their moral character: the one is the most useful, docile, and tamable of the brute creation, the other wild, revengeful, and showing an innate detestation of man."

This declaration is at issue with facts. The bison shows no disposition to attack man unless molested. He is far less dangerous than the half-wild cattle of Texas, of the Falkland Islands, and of the Peramos of the Andes. To an unarmed man in an open country there are few animals more dangerous than the common bull. Further, the bison has been found to be readily capable of domestication. (J. A. Allen: *History of the American Bison*, p. 585). There is little inducement to multiply the tame breed, as the cows are not good milkers, but in the absence of ordinary cattle it would have been of value. It remains therefore a problem why the Red Indians did not have herds of tame bison just as the Tartars of the Asiatic steppes had their oxen.

Of the carnivorous animals which enter into domestication, the dog and the cat, Swainson pronounces the former to be the "rasorial type" of the carnivorous circle. But he vouchsafes no explanation of the tameness of the cat. This animal according to his theory should be hostile to mankind, yet no creature shows a greater craving for human sympathy. This is the more remarkable as it is not a social species, and shows very little liking for the companionship of its own kind. It is to be noted that several nearly allied forms, including the wild cat of Britain, seem hitherto quite untamable.

In like manner it may be noticed that certain wild Canedæ such as *C. dukhuensis and C. primævus*, have as good a right as the domestic dog to be considered as "rasorial types" of the carnivora. Yet they show little attachment to man and no dependence can be placed upon them, although they have been occasionally employed in hunting.

A very different attempt at finding some general principle is shown in the assertion that all domestic animals are naturally gregarious. To this rule the cat and the mungus are the only exceptions. But we cannot affirm conversely that all gregarious animals have entered into domestication. The wolf, the zebra, the baboon, the hyæna, and various other forms might serve for examples.

A very curious observation is that all the truly domesticated species, both of mammals and birds, are polygamous or at least promiscuous in their amours. We have here the only difference in habits between the ordinary inmates of the farm-yard and the pheasants. The common cock, the turkey, and the guinea-fowl are feathered Mormonites, whilst the pheasant adheres to one mate. The same is the case with the mammalia. The ox, sheep, goat, horse, ass are all polygamous, whilst the dog and the cat form no permanent connections, the nurture and defence of the young devolving upon the female alone. On the other hand, the fox, which lives in pairs, has not become domesticated.

But this attempted rule also breaks down on close scrutiny. The pigeon and the parrot are monogamous; yet the former lives contentedly in a state of tameness. Parrots if kindly treated and not startled by sudden and abrupt movements, must rank among the most docile and affectionate of creatures and have even been known to die of grief if separated from their owners. This is the more striking, as in their case domestication is the result of a single life-time.

Having thus set aside all these attempts at finding a general principle in the tamability of animals, we submit that the truth is much simpler than any of them. Any species, thought desirable, can be tamed if the attempt be made judiciously and perseveringly and if the animal does not break down in the process. It is curious that this view was put forward by St. James and was doubtless the opinion current in his time. In most cases, however, many generations must pass before the original wild nature is completely and permanently subverted.

It is a not unimportant fact that in ancient Egypt one species of antelope, or perhaps more than one, was kept in herds. Thus we see that the group of tame animals is not alike at all times.

There are at least three different degrees in the friendly relations into which the lower animals enter with man. In the lowest grade we find creatures which seek his near neighbourhood, not for plunder, as do rats, mice, and sparrows, but for safety. Such are the stork, the swallow, and the martin. Many more harmless and useful species of birds would enter into this class if nesting, ratting, shooting, and trapping were put under due restraint.

In the second class come creatures which are the property of men and which display a certain kind of docility, but which do not enter into companionship with man. Here we have all kinds of cattle and poultry. The horse, if kindly treated, may pass into the third grade.

In this highest class the animal is not merely the chattel, but the companion and friend of its owner. Here we find only the dog, the cat, the mungus, the parrot, and a few song-birds.

It is a curious fact that no ruminant animal can be admitted into this class; pet lambs, kids, fawns, etc., always grow vicious as they reach maturity, and have to be consigned to the butcher.

Reviews.

English Worthies. Edited by Andrew Lang.—Charles Darwin, by Grant Allen. London: Longmans, Green and Co.

Some time must still elapse before Darwin will have received finally and definitely his position in the history of science. If evolution among minds which from training are capable of judging rightly, be hailed as victorious along the whole line, Darwinism proper, which refers the origin of species to "natural selection," is less unreservedly accepted than was the case twenty years ago. Even the intellectual calibre and the moral character of the great biologist are still a subject of dispute. In strange contrast to the estimates formed by Huxley, Romanes, and the author of the work before us, we find the censures of S. Butler and Oswald Dawson, who fiercely accuse him of insincerity, hypocrisy, and of appropriating without acknowledgment the ideas of others.

It is sad that such differences cannot be for ever decided. Mr. Grant Allen is well qualified to write the scientific biography of his master. He represents orthodox Darwinism, and represents it most ably. So fully is he master of the art of charming to slumber the watchful dragons of British Philistinism, that to him is very largely due the acceptance which the doctrine of development now finds among the educated public. His general appreciation of Darwin's relation to his forerunners and his contemporaries is throughout masterly, often brilliant. We cannot, however, in all cases accept his views as here put forward. Thus he writes:—"From time immemorial, in modern Christendom at least, it had been the general opinion of learned and simple alike, that every species of plant or animal owed its present form and its original existence to a distinct act of special creation." That such an opinion prevailed in the last century we fully admit. That it had been from time immemorial generally accepted, we dispute. Mechanical creation is not to be found in the Church fathers, and seems to have taken its rise with Milton, Ray, and Raphael.

To certain remarks on Lamarck we must also take exception. Says our author:—"A bold, acute, and vigorous thinker, with something of the vivid Celtic poetic imagination, Lamarck went to the very root of the matter, etc." Now, if Mr. Grant Allen will examine, he will find that the opposition to evolution and to Darwin's reforms has been headed by men of Celtic nationality!

We notice with regret that Oken is here under-valued. Had Mr. Allen ever heard Oken lecture, or conversed with him, he would have found something other than "fanciful parodies of the Lamarckian hypothesis."

We notice the author speaking with scant respect of biological specialists. The butterfly-catchers and plant-hunters of the world can only be convinced by long and patient accumulations of facts. . . . It was easy enough to gain the ready adhesion of non-biological but kindred (?) minds like Leslie Stephen's and John Morley's; these might all, perhaps, have been readily convinced by far less heavy and crushing artillery than that so triumphantly marshalled in the "Origin of Species." But why? Because the biological specialists knew hundreds of difficulties which to men of the Leslie Stephen and John Morley type were unknown, and therefore non-existent! All the same Mr. Grant Allen admits that it is with the biological specialists that the practical acceptance or rejection of such a theory must ultimately rest. Perhaps, also, he forgets that the opposition to the new natural history was due not to working biologists, but to divines, ethicists, novelists, and other outsiders.

In the outset of Chapter VI. we find Alfred Russell Wallace spoken of as "a young *Welsh* biologist." Was this in anything beyond the accident of birth?

Much of what the author says on the "Malthusian principle" we must reject, as not in accordance with facts.

Very captivating is Mr. Grant Allen's summary of the fate of former philosophies which had ignored development. "Dogmatic Comte was left forthwith to his little band of devoted adherents; shadowy Hegel was relegated with a bow to the cool shades of the common rooms of Oxford; Buckle was exploded like an inflated windbag; even Mill himself was felt instinctively to be lacking in full appreciation of the dynamic and kinetic element in universal nature."

There are here points many on which issue might be joined; others, still more numerous, which might be brought into approving notice. But lack of space forbids, just as, perhaps, it has prevented the author from unfolding the causes of the general rejection of evolution in France, not as elsewhere by divines or ethicists, but by bureaucratic *savants*.

The Journal of the Franklin Institute. Vol. cxxvi., Nos. 751 and 752.

The most interesting paper in these two numbers is that on "Sanitary Science in the Home," by Mrs. R. H. Richards. The author concedes that "sanitary science"—she might better have said "sanitary art"—may be traced back for 2,000 years, to the hygienic formula of Hippocrates, "Pure air, pure water, and a pure soil." But it seems very probable that the hygienic precepts to be found in the Pentateuch and in the sacred books of the Buddhists are fragments of a knowledge of the laws of health fully on a level with our own, and greatly in advance of our present practice.

Mrs. Richards insists on sanitary reforms as being to a great extent an attempt to counteract the evils resulting from the existence and the increase of great cities. Whilst recognising the general correctness of this view, we must not forget that intensely, desperately unsanitary conditions may and actually do prevail in small villages and in scattered dwellings, be they baronial halls or labourers' cottages. The author, however, seems to us to misinterpret the crowding of population into urban districts. She quotes from a story by George W. Calle this remarkable passage: "They had done that dreadful thing which everybody deprecates and everybody likes to do—left the country and come to live in the city." Now, this view, as far as Britain is concerned, is a mistake. With us everybody does not "like" to come to live in the city. The stream flowing townwards consists of the poor who cannot find employment in the rural districts, or who fancy that in London they may earn higher wages. At the same time there is a stream of the wealthy flowing outwards, leaving the town and going to live in the country. We distinctly recognise city life as a *pis aller.* Our civilisation, in so far as it is a reality, would not be thrown back fifty years, as Mrs. Richards thinks, if the population were dispersed. But this is a subject not coming directly within our purview, and upon which, consequently, we do not wish to enlarge.

Heed should be given to a passage quoted from Dr. Wight, "The unsanitary conditions of school-buildings slacken the speed of educational progress more than one-third." Here is much truth, yet unsanitary conditions are not confined to school-buildings alone, but extend to educational systems which in pupil or teacher exact brain-work under the stress of anxiety.

The burden of Mrs. Richards's song, and a very praiseworthy one, is that the public must be individually trained in sanitary lore, and that they must be prepared to sacrifice whatsoever stands in the way. Till this is done legislation must remain a dead letter. Lastly, we must remember that the task of sanitary reform is not so much to increase the quantity as to raise the quality of human life. The "masses" of our great cities are an essentially morbid product, developed under unnatural conditions.

CUSTOMS OF SAVAGE RACES.

Lecture Delivered by Sir John Lubbock, M.P., F.R.S., to the Working-Classes of Bath.

(Continued from p. 319.)

THE lowest savages, indeed, appear to be entirely devoid of any belief in a future life. A friend of Mr. Lang's once tried to explain to an Australian the idea of a soul, but in vain he tried to describe a living entity, without a body, without arms or legs, or a mouth to eat. The native could not believe he was serious, and when he did realise it the more serious the teacher was the more ludicrous it appeared to the black, but when once grasped it is accepted with unwavering faith. The Ancient Britons are said to have lent money readily on promise of repayment in the next world. Not long ago a Hindoo thought he had been cheated out of 40 rupees, upon which, with his mother's full consent, he cut off her head in order that her spirit might torment the man who had robbed them. But a belief in the survival of the spirit is by no means the same as one in the immortality of the soul. In some parts of Polynesia it is supposed that the common people are mortal, and that the chiefs only go to the land of spirits; others think that while men have souls, this is not the case with women. Some negro tribes believe that their father and mother are still alive (for do they not visit them in their dreams?) but of their grandfather they say sadly, "*Amekwisha,*"—"it is finished." The firm faith of the New Zealanders in the existence of another world beyond the grave made it a serious thing to kill an enemy, for what was the result? Embittered by his defeat the dead man went to the land of spirits, prepared his revenge, and when his old enemy died took him at a terrible disadvantage. On the other hand, if a man was eaten as well as killed, there was an end of him—at least, of his separate existence. His spirit, strength, and courage were absorbed into, and appropriated by, the victor. Hence, in war, the conquerors were most anxious to eat any chiefs who had fallen in battle.

It is not an uncommon belief that as a man dies so he will rise again, and that this applies to the body as well as the mind. Moreover, the way to the land of spirits was long, dangerous, and beset with demons. Many perished on the way, and no one who was not in possession of all his faculties could hope to arrive in safety. So convinced were the Feejians of this, that as soon as a man felt the least sign of old age he was anxious to start on his long journey. Mr. Hunt tells us that one day a young man in whom he took much interest came to him and invited him to attend his mother's funeral, which was to take place the next morning. Mr. Hunt accepted the invitation and went. As he walked along in the procession he was surprised to see no corpse, and asked the young man where his mother was, when he pointed to a woman who was walking along just in front, to use Mr. Hunt's words, "as gay and lively as any of those present. When they arrived at the grave she took an affectionate farewell of her children and friends, and then submitted to be strangled." So general, indeed, was this custom in the islands that in many villages there were literally no old people, all having been put to death; and if we are shocked at the error which led to such fearful results, we may at least see much to admire in the firm faith with which they acted upon their religious belief.

In a great many cases there are supposed to be deities of Disease, of Misfortunes, and of Crimes. These wicked spirits naturally encourage evil rather than good. In one part of India, when small-pox was prevalent, there was a temple to the goddess of that terrible disease. An energetic friend of mine, who was sent as magistrate there, in spite of some opposition had all the people vaccinated. The disease ceased, much to the astonishment of the natives. But the Priests of the Goddess of Small-pox were not disconcerted. One morning they came as a deputation to my friend. They said, "We have made a mistake. We have worshipped the wrong Deity. You are evidently the true God of Small-pox," and they petitioned him to give them some emblem or representation of himself which they might enshrine in their temple. In fact, that mysterious problem of the origin of Evil which has exercised so many of the highest intellects, the savage solves by his creation of evil deities. We who are fortunate enough to live in this comparatively enlightened century hardly realise how our ancestors suffered from their belief in the existence of mysterious and malevolent beings; but among savages we find life still overshadowed and embittered by those awful apprehensions. From such evil beings sorcerers and witches derived their hellish powers. No one was safe. No one knew where danger lurked. Actions, apparently the most trifling, might be fraught with serious risk; objects apparently most innocuous might be fatal. In some cases an image was made to represent the persons whom it was wished to murder, and it was supposed that the destruction of the image involved the death of the victim; in others it was supposed enough to obtain a hair, or even a piece of dress, the destruction of which would involve that of its owner. In others, even the knowledge of a person's name was sufficient to place them in the power of the sorcerer. Hence we find that in many races a person's true name was kept a profound secret. As man, however, gradually became better acquainted with the world in which we live, his religious conceptions were raised, he was able to form a higher ideal of the divine nature, not only as respects power but with reference to morality also. The assistance which science has thus rendered religion has not, I think, been sufficiently appreciated. This truth by no means holds good with reference to the lower races only. Our own ancestors in the dark ages, long after they were nominally Christians, clung to superstitions which the light of science gradually enabled them to shake off. Gradually, however, the progress of knowledge freed us from this terrible dread. We do not, I think, generally realise how much our ancestors suffered from the overshadowing horror of this fearful superstition, and how much in this respect the advance of science has raised and purified, not indeed Christianity itself, but our appreciation of it. But however this may be, as regards the lower races, I think we see that as men have risen in civilisation, their religions have risen with them: they have gradually acquired higher and purer conceptions of divine power. Nevertheless, though there is much in the religion of savages which is erroneous and even grotesque, it is not less worthy of respect as an attempt to arrive at the truth and to fulfil a duty.

Some of you whom I have the honour of addressing this evening will, I have no doubt, have the opportunity of observing savages in their native abodes. I trust I may express the hope that if so, you will avail yourselves of every chance of adding to our knowledge of this interesting branch of science—a science interesting to the philosopher; still more to the Englishman, belonging as we do to an empire which comprises many races of men, and people in every stage of civilisation; and one which is most encouraging in its results, since it appears to prove that, though there have been exceptional periods of degradation and decay, the history of mankind has on the whole been one of progress, and that we may fairly look forward to the future with confidence and with hope.

INTERNATIONAL GEOLOGICAL CONGRESS.

THE Reporter (Mr. J. E. Marr) of the British Sub-Committee on the Classification and Nomenclature of the Cambrian and Silurian Rocks, states in his report that "in the case of the Cambrian and Silurian, there is a pretty general agreement as to the position of the boundaries of the various series which make up the systems; but, on the other hand, it is hopeless to attempt any grouping of the series into these two systems which shall give satisfaction to all parties." After reviewing the opinions of the various authorities, he gives the following table embodying their views:—

Sedgwick	Murchison	Lyell and Hicks.	Lapworth.	Geological Survey.
Silurian	(1) Upper Silurian	Upper Silurian	Silurian	Upper Silurian
(2) Upper Cambrian	Lower Silurian	Lower Silurian	Ordovician	Lower Silurian.
(3) Middle Cambrian	Primordial Silurian	Cambrian.	Cambrian	
Lower Cambrian	Cambrian			Cambrian

(1) Murchison and Geological Survey include Lower Landovery in their Lower Silurian. (2) Upper Cambrian, nearly=Cambro-Silurian of some authors. (3) Includes Arenig, which is placed by Lapworth in his Ordovician, and by Lyell and Hicks in their Lower Silurian.

This subject gave rise to interesting and animated discussion, which took place on Tuesday the 18th September, at 10.30.

As all the reports were taken as read, the Chairman of the Committee (Professor Capellini) called upon Dr. Hicks to open the question, and the latter gave a short sketch of the origin and history of the difficulty declaring himself to be, as a pupil of Mr. Salter, and equally attached to the Geological Survey and to Cambridge, simply an independent seeker after truth. He laid stress on the point that there were three distinct faunas, the lowest being the one that he had so large a share in discussing, while the middle, the part about which the whole of the disagreements has arisen, is that containing the primordial fauna of Barrande. The division line between these is the top of the Tremadoc with its Olenus fauna, the Palæontological break being largest here. The Cambridge school, on account of the physical unconformity at the Llandovery beds, make their great division in the latter. Dr. Hicks proposed that Professor Lapworth's suggestion of Ordovician for the middle series should be adopted, as solving the difficulty and giving their own way to both the Geological Survey and the Cambridge School.

Mr. Marr, who began by expressing his regret at the absence of Professor Hughes and its cause, followed the same line of thought as Dr. Hicks, and supported the adoption of the term Ordovician. He, however, though that the Cambrian-Silurian rocks formed a whole so coherent and with such a common facies that a designation for the whole group would be of great advantage and proposed the name Barrandian in that sense.

Professor Lapworth, in an emphatic address, accentuated the views of the preceding speakers, describing, with the aid of a large section of the geological formations, the relative importance of each of the three great periods, and pointing out that as the Mesozoic was divisible into the two great Jurassic and Cretaceous groups, so the Palæozoic had two main divisions, the *proterozoic* (Cambrian, Ordovician, and Silurian) and the *deuterozoic* (Devonian, Carboniferous, and Permian). Against Murchison's classification he urged that Murchison's stratigraphical work was full of errors, and that where the latter had mapped a regular succession, he (Professor Lapworth) had traced an unconformity over a hundred miles, and that a large part of the Upper Caradoc had been completely swept away. As to the Taconic he had heard only two days ago that its fauna was quite below the Cambrian, and it was thus outside the question. In conclusion, he affirmed his belief that his own term (Ordovician) must inevitably be adopted, and that no result the Congress might arrive at would in any way affect its ultimate acceptance.

Mr. Walcott, palæontologist, United States Geological Survey, in giving the results of his work in America, stated that the true Taconic fauna of Emmens, or Olenellus fauna, containing 42 genera and 112 species, occurs below the Paradoxides fauna both in America and Europe. He supported the classification and nomenclature of Professor Lapworth.

Dr. Sterry Hunt, of Montreal, also supported Professor Lapworth's terminology, and said the Taconian was below Barrand's primordial fauna, and the Cambrian corresponded to the Urschiefer. He opposed Mr. Marr's suggestion of Barrandian as a mere personal name, and on that ground objectionable.

Professor Torell, Stockholm, did not accept the name

Ordovician, but kept to Murchison's classification, and desired to include in the Cambrian the Olenellus beds.

Professor Gosselet, of Lille, objected to the newer classification, because the fauna of the so-called Ordovician is so nearly related to the Upper Silurian. Professor Lapworth's protero and deuterozoic seemed to him also unwise, on account of the great development of the Devonian out of England, as in the Ardennes.

Professors Dewalque and Kayser spoke in the same sense.

Dr. A. Geikie, Director-General of the Geological Survey, referring to his long connection with Sir Roderick Murchison and the general acceptance of the views of the latter, stated that while he was quite willing to change his opinions on due cause being shown, he did not find a sufficient reason in this case. He expressed regret that Professor McK. Hughes, the present head of the Sedgwickian school, had been obliged to leave the Congress, and thought the question could not be settled in his absence. As to the term Ordovician, he considered it absolute nonsense, and thought the classification of Murchison sufficiently clear and well known.

Professor Blake, of Nottingham, who followed, was the first English member who used the French language, the previous English speakers' remarks, however, being, on the proposition of Professor de Lapparent, summarised in French in a most lucid and admirable manner by Professor C. Barrois, of Lille. While supporting Professor Lapworth's views, Mr. Blake would add a fourth fauna, that containing Olenellus, to which he would apply the name Monian.

Professor de Lapparent, of Paris, urged the desirability of deciding whether the Cambrian should only include fossiliferous strata or should extend down to the crystalline schists.

Mr. Delgado referred to the classification in three divisions adopted in the Portuguese map.

Mr. Hull objected to the term Ordovician, on the ground that there was no serious reason for its introduction, and because the Lower Silurian of Murchison had priority, besides being adopted all over the Continent.

Professor Barrois pointed out that the term Silurian, as used on the Continent, did not lend itself to synonymy, as it corresponded to both the Ordovician and Upper Silurian.

Mr. Gilbert, of Washington, U.S.A., desired to hear the opinions from all parts of the world. It was well, he thought, not to settle the terminology by reference to one locality only, and, if possible, only after extended investigation, as in each locality the limits of the beds were different.

As there seemed no prospect of a general agreement, the Chairman decided not to put it to the vote.

After referring to the death, since the Berlin meeting, of M. Fontannes, he made a proposition, which Dr. Sterry Hunt seconded, to send a telegram, in the name of the Congress, to Boella, the birthplace of Quintina Sella, the geologist, where a monument to the latter was to be unveiled on the following day.

On Wednesday the basis of the discussion on Crystalline Schists was supplied by eight monographs by authors of well-proved ability. Dr. Sterry Hunt communicated a paper on the crystalline schists, setting out with a summary of the theories on their origin. He pointed out that the geologists of our day are divided into two classes, as long as they admit for these rocks an igneous (Plutonic) origin, or an aqueous or so-called Neptunian origin. Among the Plutonists there are still two schools, the one regarding the foliaceous structure of these schists as due to the lamination of an igneous mass submitted to a strong pressure. For this school the crystalline schists as well as the granites, the trachytes and the basalts, are eruptive rocks. This manner of explaining the origin of the crystalline schists may be called the exoplutonic or volcanic. For the other Plutonian school, these same crystalline schists are the products of the consolidation of the igneous matter of the globe beneath a crust formed by surface-cooling; the schistous structure being the result either of currents established in the mass still liquid and heterogeneous, or of a segregation in the mass during crystallisation. To this second igneous school may be given the name Endoplutonic.

The Neptunists on their part are divided into several schools. Werner and his disciples believed that the crystalline rocks, both granitic and schistous, have been deposited successively from a universal ocean, which they conceive as a chaotic liquid holding in solution the elements of all the primitive rocks. This supposed derivation by a slow crystallisation from a primordial chaos may be named the chaotic hypothesis. Into this purely Neptunian hypothesis the notion of a fiery centre does not enter, but certain Platonists who admit this notion have devised a *thermochaotic* hypothesis, propounded by Poulett Scrope in 1825, and subsequently maintained by Daubrée.

Another Neptunian school was that of Hutton, who supposed that the crystalline rocks are derived from the consolidation and crystallisation, by the action of internal heat, of the sediments deposited by the water at the bottom of the sea, these sediments being the detritus, either of the endoplutonic or the exoplutonic rocks. This view, which the author calls the metamorphic hypothesis, has the defect of not taking account of the chemical changes which the bulk of the silicates undergo during the degradation of the crystalline rocks and their transformation into sands and clays.

Dr. Sterry Hunt, among these hypotheses, gave the preference to that of Werner. He did not, indeed, venture, in the present state of our chemical knowledge, to suppose all these bodies simultaneously present in solution, even at the elevated temperature which the thermochaotic hypothesis supposed. But he sought to conciliate with the known facts the notion that a great part of the primary rocks, both granitic and schistous, had passed through the state of an aqueous solution. To this hypothesis he gave the name *crenitic*. A full discussion of this view may be found in the author's work "Mineral Physiology and Physiography."

Professor Albert Hein discussed the classification of the crystalline schists. He concluded that the texture of the crystalline schists of the Alps had been variously modified by dynamo-metamorphosis.

Professor Lory examined the constitution and the structure of the mountain masses of crystalline schists of the Western Alps. He pointed out that a substitution of chloritic schists by protogine in the mountain mass of Pelvoux, as in that of Mont Blanc, presents itself precisely along the intra-alpine limit of the Mont Blanc zone, a limit marked by a grand fault, which may be followed for more than sixty leagues from Fallouise to Airdo. Between the two sides of this great fault are observed the striking contrasts of the rudimentary trias of the zone of

Mont Blanc, with the enormous development of the quartzites of Tarantaise and the Valais.

Professor J. Lehmann contributed a critique on certain recent researches and speculations on crystalline schistous rocks.

Dr. A. Michel Levy discussed the origin ot the primitive crystalline formation.

Dr. A. C. Lawson, of the Geological Survey of Canada, considered the Archæan geology of the region north-west of Lake Superior.

G. F. Becker, of the U.S. Geological Survey, treated of the crystalline schists of the coast ranges of California. He observed that the crystalline schists of the coast ranges are mingled with crystalline rocks which cover thousands of square miles. A great portion of these rocks were laid down as sedimentary during the Neocomian. Soon afterwards they were upheaved with extreme violence, and were subjected to the action of magnesian solutions, probably approaching to temperatures above the average, and perhaps approaching the boiling point.

Professor Lory, in opening the discussion, spoke on the crystalline schists of the Western Alps. He pointed out that they were composed of a regular series of *assises* of constant mineralogical characters. Their structure was independent of dislocations. One crucial observation for any one seeking to explain their mode of origin was furnished by the existence of crystallised silicates in the secondary and tertiary formations of the Alps; garnets, mica, tourmaline, in the schists of the Trias; and crystals of albite in the Eocene limestones. They were thus formed in the crystalline silicious rocks of every epoch. The presence of these crystals had no connection with the intensity of the mechanical movements, for they were even found in horizontal beds. The crystals were formed in each geological epoch shortly after the period of sedimentation, and their development was connected with the mode and formation of the rocks themselves, and depended upon the original conditions of the deposit. He agreed with the theory of the hydrothermal origin of the crystalline schists.

Mr. Mattirolo gave some interesting details about a metamorphic Permian rock widely distributed in the Western Alps and Apennines. It presented a gneissic-porphyritic structure, and he had classified it under the name of Besimandite.

Mr. M'Farlane declared himself a Plutonist, and read to the Congress his opinions on the origin of the crystalline schists.

Professor Issel insisted on the analogies which his observations presented with those of M. Lory. The schists and nummulitic limestones with crystallised silicates owed their origin to hydrothermal action. This most assured fact put us in sight of a rational explanation of the formation of the crystalline schists.

Professor Heim remarked that many questions presented themselves to any one beginning the study of crystalline schists. They had been subjected to general metamorphism, to modifications by contact, and by mechanical contortions. It was, therefore, an advantage to seek the key of the problem in the study of the transformed sedimentary rocks. In the two cases, in fact, common characters of structure might be observed—cleavages, entirely linear, surfaces, contortions, etc. These sedimentary formations, mechanically contorted into synclinal curves, contained crystallised silicates. They were analogous to those which were developed by metamorphism of contact; but they could not in this case be attributed to that cause. The extent of the mechanical phenomena was the predominant fact in the Alps, and it complicated the study of the subject. In the parts of the earth less affected by mechanical contortions one might hope to find an explanation of the origin of the schists.

Dr. Sterry Hunt declared himself to be a disciple of Werner. He believed that the old granites as well as the basic gneisses were of aqueous origin and were chemically deposited. This action had continued since the most remote period, and was going on at the present day with diminished intensity.

Dr. Hicks said that the crystalline schists, when they occurred over a great area, were, he believed, invariably of the pre-Cambrian age. He believed that the massive gneisses were originally igneous rocks which had undergone much change. The mica and chloritic schists he believed to have been formed mainly from volcanic ashes and muds. He admitted that rocks of volcanic origin could change at any period of the world's history into crystalline schists under favourable conditions, such as pressure, mechanical movement, and percolations of liquid. The detrital rocks would show certain important changes, but only partially simulated the older rocks. The porcellanites, quartzites, and clay slates were detrital rocks. Sediments repeatedly deposited gradually lost their power of complete changes, hence the crystalline schists were mainly of pre-Cambrian. The Pebidian rocks in Wales yielded most instructive evidence in support of the above views.

M. de Lapparent, who now occupied the chair in the place of Dr. Geikie, explained very summarily his personal views on the primitive formation. The formation had a distinct existence, it was independent of the following periods, and the explanation of its origin should be found in the combination of chemical, mechanical, and calorific actions carried on to their *maximum*.

Professor O. Torell explained that he had distinguished in Sweden two granites, one eruptive and the other ancient, passing into gneiss.

Mr. M'Pherson called attention to the regularity presented by the succession of three great groups of crystalline schists in Spain—1, granitoid gneiss at the base; 2, micaceous gneiss with limestone; and, 3, mica schists.

M. de Lapparent, in closing the discussion, referred to the facts collected in the published memoirs of the English Committee.

On Thursday the question discussed was, whether for the period immediately preceding the present, the term Quaternary should be used as of equal value with Secondary, Tertiary, etc., or the period should be called Pleistocene, and considered as merely a part of the Tertiary. The term Quaternary has found much more favour on the Continent than in Great Britain, where the Lyellian name, Pleistocene, is almost universally adopted. As might have been expected, the foreign geologists mostly were in favour of Quaternary. This, however, was not universal, Professor Renevier, of Lausanne, who began the discussion, adhering to the term Pleistocene as a division of the Tertiary. This opinion he held, because no important organic type marked the period except the appearance of man, and this fact would not be considered as fully established. The glacial period also is not characteristic of the period, because it began in the Pliocene, or perhaps before.

Professor de Lapparent thought that the very important event of man's appearance justified the separation of the period from the Tertiary.

M. Gaudry, the great French vertebrate palæontologist of Paris, also would separate the Quaternary from the Tertiary, the former being the present epoch in its fauna. As the Primary era was that of invertebrates, then that of fishes, the Secondary of cold-blooded reptiles, the Tertiary ot warm-blooded mammalia and birds, so the Quaternary is the epoch of the domination of man.

Professor Sacco, of Turin, in support also of the Quaternary, adduced the argument that a great movement of the earth's crust and a change of climate had taken place between the Pliocene and Quaternary.

Dr. Blanford agreed with M. Renevier in rejecting the term Quaternary, and joining the latter to the Tertiary. The introduction of the personal element, the appearance of man, into the question was to be regretted. He pointed out that in Asia the Tertiary was naturally divided into two great series, an inferior marine of 2,500 feet of eocene and miocene, and a superior terrestrial or freshwater series of deposits of 10,000 feet thickness from the Pliocene to the present day.

Professor Gosselet, of Lille, as an additional argument in favour of Quaternary, instanced the great development of fluviatile conditions and erosion of great valleys.

Professor Renevier objected to the importance attached to the appearance of man alone; besides, man probably appeared in the pliocene and perhaps before. No new organic type characterised the Quaternary.

Dr. John Evans was in favour of possessing a term to indicate the human period, without giving it an absolute value as compared with other epochs.

Professor de Lapparent added to his former remarks the following geological reasons for Quaternary:—The foraminiferal and nummulitic accumulations characteristic of the Tertiary; the great explosive volcanic phenomena of the Quaternary following the fissure eruptions of the Tertiary; and, finally the extraordinary development of glacial conditions in the Quaternary.

Professor Pilar, of Agram, supported the use of Quaternary as equivalent to anthropozoic, and of the same importance as cænozoic, mesozoic, and palæozoic.

The President, Professor Prestwich, agreed with Professors Gaudry and Lapparent in adopting the special term Quaternary. What is of importance in history, he said, is not the long periods of time but great events, and the appearance of man was one of these. In addition to this, there were the production of cosmic phenomena and an important change of climate. He adopted for this quaternary period the term Pleistocene, and considered it as beginning with the base of the forest-bed, the epoch of the appearance of the last fauna, and the introduction of the present climate. It will thus be seen that Professor Prestwich uses Lyell's term Pleistocene, but separates it from the Tertiary.

On Friday the Chairman, in opening the proceedings, informed the Congress that an invitation, endorsed by all the American geologists attending the Congress, had been received from the City of Philadelphia for the holding of the next Congress (that of 1891) at Philadelphia.

The invitation was accepted by acclamation.

M. Hanchecorne then submitted to the Congress the first proof of a section of the international geological map of Europe, the preparation of which was decided upon at the Bologna Congress. The map is drawn on the scale of 1 to 1,500,000 from the most recent topographical documents furnished by the different nations. The geographical part of the work was done between the meetings of the Bologna and Berlin Congresses. The geological divisions traced on the sheet submitted to the Congress by M. Hanchecorne were adopted conformably to the decisions arrived at by previous Congresses. By the principle adopted with regard to the colouring, each great group is represented by one particular colour, and the different subdivisions by various shades of the same colour. The deeper colours have been chosen for the most ancient formations, a single exception being made in the case of the coal measures, which, according to long established custom, are coloured black. For the volcanic rocks it has been found necessary to vary the tints adopted according to the differences of age and of chemical composition (acid or basic). The sheet submitted, which was only a proof, and which was open for further improvements, bore twenty-four different shades of colours for the sedimentary rocks, three for the Archæan formations, and nine for the volcanic rocks.

Professor Prestwich, in the name of the Congress, presented his thanks and congratulations to the committee which had had the map in charge for the remarkable piece of work which they had submitted.

The discussion on the crystalline schists was then resumed.

Dr. Hull, on behalf of Mr. Kilroe, of the Geological Survey, presented some rocks from county Donegal remarkable for their double schistosity. The mica flakes were disposed in two main directions, in relation with two distinct periods of metamorphism. Dr. Hull, speaking for himself, considered, as a fundamental question in the study of metamorphism, the distinction to be established between the results of mechanical agencies and hydrothermal agencies. The former had determined the foldings, cleavages, etc., and the latter the formation of new mineral combinations. Mechanical movements had assisted those combinations, but they had not produced them.

Dr. Sterry Hunt enumerated the three principal hypotheses proposed for the explanation of the origin of the gneissic rocks. One predominant fact was the distinction of different stages of crystalline schists and of their constant regular succession from the fundamental gneiss to the uppermost crystalline schists.

M. Gosselet believed that the metamorphic rocks of the Ardennes ought to be attributed to mechanical agencies; they could not be connected with the phenomena of contact. He differed from the opinions expressed by M. Lory. If, in the Ardennes, the more markedly broken and folded rocks were less crystalline than those which were slightly curved or horizontal, it was because, in the first case, pressure had produced a mechanical operation, and, in the second case, the mechanical operation had been converted into heat. Crystallised minerals, therefore, owed their origin to the action of overheated water contained in the rock.

Mr. Blake, in describing the crystalline schism of Anglesey, insisted on the action of pressure. The effects of pressure could not be misunderstood, and it was even possible to distinguish the effects of static pressure (schistosity) from the effects of dynamic pressure (false schistosity) when these two effects were successive.

Mr. Claypole referred to the different rocks of the Alps which contained crystals and organic forms.

M. Renevier drew attention to the determinations of fossils made by different *savants* in certain crystalline rocks of the Alps, of Norway, and of the Ural. He opposed the theory that supposed all the crystalline schists to be of Archæan age. They were generally pre-Cambrian, but in some regions of a more recent age, as in the Swiss Alps.

Dr. Sterry Hunt rejected the idea attributed to him, according to which the crystalline schists were without exception of the pre-Cambrian age. The formation of minerals and even of silicates had been carried on in all periods, but with a diminishing force. These crystallisations took place at all times under the action of mineralising waters—perhaps at the bottom of the old seas, perhaps in the neighbourhood of, or in contact with, the volcanic rocks. The pressure to which certain geologists attributed so important an influence on the phenomena would not be able to produce heat by itself. For that the movement must have been checked. The experiences of Spring had furnished the most evident proof that the most powerful pressures had not produced heat. It was the chemical affinities which gave birth to the minerals.

Professor Heim declared that the trunks of trees stated to be found in the gneiss of Switzerland were not found in the real gneiss but in the intercalated beds and in sericitic pseudo-gneissic rocks. In the same way the belemnites were found in the schistose rocks, containing albite, garnet, chlorite, and mica.

Colonel Delgado called the attention of the Congress to the graptolitic schists with chiastolite exhibited by him, and the modifications of which were due to the proximity of granite.

M. de Lapparent drew attention to the classical locality of the chiastolite schists with fossils—namely, Lobau in Brittany. From a general point of view he insisted on the power of pressure to develop heat, but if, as pressure, it was really incapable of this, it produced a movement instead when its effect was not checked by the absolute resistance of the wall. This movement, when it was not identical for all the elements, caused a friction, and the change engendered heat. However this might be, all metamorphic, mechanical, and chemical effects were limited in extent, and it was this which distinguished their results from that universal crystalline formation which lay at the base of all the formations.

Professor Lapworth called attention to the special point of view, based exclusively on facts, which had always been adopted by the English geologists. When present causes were sufficient there was no need to have recourse to other agencies. This was the school of Lyell, of Hutton, and of Darwin. The known evolution of organic nature at the Cambrian epoch bore witness to the fact that numerous periods had preceded. The sedimentary and eruptive rocks formed in those distant times were necessarily the most modified. In fact, the rocks of the most recent periods continued their process of transformation according as one descended in point of time and in depth of the formation. His personal researches in the north-west Highlands had shown him that the crystalline schists formed an inferior division to the palæozoic formations. He explained the sweeping modifications to which they had been subjected in accordance with the principles of Heim and of Lehmann—such as mechanical actions, volcanic injections, and others.

Professor Heim believed that the heat might be produced by shocks and successive movements analogous to those observed in the earthquakes of the present time. But the dislocations *en masse* of the contorted regions had not had this effect.

M. de Lapparent equally attributed a production of heat to the sliding of the particles, mineralogically different, over one another.

Mr. Callaway presented the result of his researches concerning the origin of the crystalline rocks of the north-west of England.

On Saturday M. Hanchecorne announced that he had received the geological map of Great Britain, for use in the preparation of the European map.

Professor K. von Zittel then gave the names of the gentlemen appointed on the American Provisional Committee for the arrangement of the next meeting of the Congress. The gentlemen were Messrs. Dana, Frazer, Gilbert, Hall, Marsh, Newberry, Sterry Hunt, and Walcot.

Dr. Persifor Frazer said that he was requested to give some explanations in regard to the invitation which he had presented to the Congress on behalf of the citizens of Philadelphia. The year 1891, in which the Congress would again meet, was the centenary of the University of Pennsylvania in its present organization, and great preparations were being made to celebrate this event. No doubt the occasion would draw together a large number of the men of letters and science best known throughout the world; and, besides this, the International American Congress would meet at the same time in Washington, and assurances had been received from some of its members that they would attend at the Philadelphia gathering. These facts furnished some of the reasons for the invitation to the Geological Congress to meet next at Philadelphia. The invitation was remarkable in the signatures attached to it. In addition to the mayor and the principal municipal officers, the Judges of the United States and State Courts, the professors of the Universities, etc., the presidents of the railways, and many others had joined in the invitation, so that there would be no doubt as to the warmth of the reception that would be accorded to members of the congress. The presence of the principal officers of three great railways insured that the expenses of travel would be reduced to a *minimum*. Excursions would be arranged to the Rocky Mountains, and to the gold and silver regions, to Georgia and North Carolina, to the great lakes, and to Canada.

Professor von Zittel expressed the thanks of the Congress to Dr. Frazer for his announcement, and felt sure that the Congress of 1891 would be successful.

M. de Lapparent then presented the report of the committee on the subject of voting. In order to avoid the inconvenience which might arise from the great numerical superiority of the members belonging to the country in which the Congress is held, the committee recommended that the votes should be decided in the following manner:—The votes of native members and the votes of the foreign members should be taken separately. If the votes of the two divisions were accordant, the result was to be accepted; but if they differed, the subject was to be considered immature for settlement. Matters purely theoretical should not be voted upon by the Congress. These recommendations were carried unanimously. M. de Lapparent then expressed his appreciation of the courtesy and respect for the individual which had been shown by the English members of the Congress. They had been in a sufficient majority to carry any proposition; but, instead of using their power, the London Congress had been signalised by the adoption of the foregoing rules for voting.

M. Capellini announced that the council had found it necessary to continue the International Commission on Nomenclature, although certain modifications of its functions had been made.

The Commission, which included representatives of all countries, chose M. Capellini for its president, and M. Dewalque for its secretary.

Professor Prestwich then delivered his concluding address as president of the Congress. He said:—We approach the end of the Congress and we can now congratulate ourselves upon the results obtained. The first sitting was devoted to the discussion on the divisions of the Cambrian and Silurian systems, and although no vote has been taken, the opinions expressed have demonstrated that all are in accord for retaining the three groups or zones of Barroude and Murchison. But the necessity is not seen of making, as some members proposed, the intermediate zone a separate system. Thus the *status quo* of the Upper and Lower Silurian for the beds as far as the Tremadoc, and of the Cambrian for the group below, will not be affected. Two sittings have been devoted to the discussion on the origin of the crystalline schists by hydrothermal chemical action or by movements, for each of which causes powerful arguments have been advanced. The Congress had received and printed in advance memoirs by eminent geologists, which will be valuable documents in the solution of this important problem. Another sitting took cognizance of the connection between the Tertiary and the Quaternary, the result of which is that, although opinions are divided, the majority of members approve of retaining the term Quaternary. Although in these cases votes have not been taken, the discussions had a great interest in the demonstration of the ideas which predominated among the most distinguished geologists. According to the resolutions adopted by the committee on voting, it will be easier in the future sessions to arrive at more positive conclusions. The reports which the Committee of Nomenclature has received from the national committees, and which are printed, are of great importance and will serve as bases for a more settled classification. The unavoidable absence of Professor Hughes is much to be regretted, since he took so active a part as President of the English Committee. It is to be regretted also that the great palæontological work of all the known fossils is about to be abandoned for the present, by reason of the great expenses which it involves. One of the most important objects of the Congress has been brought to a conclusion—the unification of colours and shadings in maps, and the Committee on the Geological Map of Europe announce to us that the publication of this fine map will not be delayed.

After the usual vote of thanks the proceedings of the Congress terminated.

STRANGE PHYSIOLOGICAL DEFECT.—It appears that some persons have a defect in the sense of smell, analogous to colour-blindness. An instance is known of such a person who cannot distinguish the scent of violets from that of garlic, though his recognition of other smells seems normal.

TECHNICAL EDUCATION NOTES.

AGRICULTURAL LECTURES.—The annual course of lectures on agriculture will be given at the City of London College, Moorfields, on Tuesday evenings, at 7 p.m., beginning on October 2nd, by Mr. Bernard Dyer, consulting chemist to the Essex, Leicester, and Devon Agricultural Societies. The lectures will treat of soils, plant life, manures, tillage operations, live stock, dairying, food, etc. The course will be in connection with the Government Science and Art Department, and will end in May. In addition to the college and other prizes, the Saddlers' Guild offers, as in former years, a prize of £5 5s. to the student who passes the best examination in chemistry and agriculture.

TECHNICAL EDUCATION IN THE POSTAL TELEGRAPH DEPARTMENT.—The thirteenth session of the Telegraphists' School of Science, which was established in the Central Telegraph Office in 1876, is about to commence, and a good and useful programme is announced, embracing classes in telegraphy, magnetism and electricity, mathematics, chemistry, workshop and laboratory practice, and a new and special course of instruction in relay and cable manipulation, the *raison d'etre* of this last class being the approaching transfer of the Submarine Telegraph Company's system to the Post-Office. The principal of the school is Mr. W. Slingo, who is assisted by three of his old pupils. The school is now a recognised portion of the Central Telegraph Office, and has for some time received considerable support from the Department, as indeed it should, seeing that it derives very material profit from the work carried on. Last year's classes were unusually successful, taking at the examinations of the Science and Art Department and the City and Guilds Institute eighty-one certificates, as compared with forty-one in the preceding year. In the Telegraphy examinations twenty-two certificates were gained by the school out of the seventy awarded throughout the kingdom. A valuable prize, consisting of a bronze medal and £3, was also gained. During the past five years thirty-three medals and £85 have been awarded as prizes throughout the kingdom; and of these, six medals and £24 have been gained by this school. In electrical instrument-making, the honours prize (consisting of a bronze medal and £5) was also gained by the school. Altogether more than 350 members of the staff of the Central Telegraph Office have passed through the school, and have gained upwards of 500 certificates.

CITY AND GUILDS OF LONDON INSTITUTE.—The classes at the Technical College, Finsbury, for the session 1889 will begin on Monday, October 1st. They are divided into five departments—viz. (1) Mathematics and Mechanical Engineering; (2) Electrical Engineering and Applied Physics; (3) Industrial and Technical Chemistry; (4) Applied Art; (5) Special Trade Classes. The classes are conducted both in the daytime and in the evening. The entrance examination for day students took place on Wednesday, September 26th, at 10 o'clock a.m. Scholarships of £30 a year each, and the Holl Scholarships of £20 a year, all tenable for two years, were awarded (in accordance with the several schemes) on the results of the entrance examination.

SCHOOL BOARD EVENING CLASSES.—We are asked to state that the seventh session of the evening classes for male and female pupils, conducted by the School Board for London, began on Monday evening, the 24th inst. As many as 16,320 persons received instruction in the classes last session. They are held in every district of the metropolis, and meet, as a rule, on three evenings a week, between the hours of 7.30 and 9.30. The subjects of instruction are reading, writing, dictation, spelling, arithmetic, book-keeping, drawing, grammar composition, geography, history, singing, algebra, mensuration, domestic economy, physiology, sound, light and heat, mechanics, magnetism, and electricity, etc. Special classes for instruction in French, shorthand, science and art (in connection with the Science and Art Department) are also opened where there are enough pupils. Where possible the Recreative Evening Schools Association, whose President is her Royal Highness the Princess Louise, illustrate the lessons by the magic lantern, and introduce such recreative and practical subjects as musical drill, wood-carving, modelling, etc. The work of the classes is made as interesting and attractive as possible, so that the pupils may spend pleasant as well as profitable evenings. The fee is, as a rule, 3d. per week or 2s. a quarter, or 3s. 6d. for the two quarters; and the payment of this fee entitles a pupil to attend the classes on the three evenings a week and receive instruction in any of the subjects, except those taught in special classes, where small extra fees are charged. Well-qualified teachers are engaged. Prizes and certificates are awarded by the Board.

Abstracts of Papers, Lectures, etc.

LIVERPOOL SCIENCE CLUB.—On the 14th inst. the members of this club visited the Ship Canal Works at Eastham, and through the courtesy of the contractors were taken over the ground in an open waggon drawn by a locomotive. The work of the steam navvies in the soft clay and sand, near Eastham, was very interesting, but before reaching Ellesmere Port the entire character of the work was changed by the appearance of the soft red Trias sandstone of the district. Gunpowder and other explosives took the place of the steam diggers, and the vast piles of rock on the banks showed the source of the stone for building the walls of the canal. The recently uncovered "Roman Road" was pointed out, and many other interesting sights, and the expedition was one of the most enjoyable of the season.

ANDERSONIAN NATURALISTS' SOCIETY. — The usual monthly meeting of this society was held on the 13th inst. in Anderson's College—Mr. J. Donochy, one of the vice-presidents, in the chair. The secretary read the reports of the society's excursions to the Whangie and the Falls of Clyde. At the former specimens of the bladder fern (*Cystopteris fragilis*) were found on the sides of the celebrated fissure, to view which the excursion had been undertaken. From the excursion to the Falls of Clyde fresh specimens of all the notable plants encountered were exhibited. Mr. W. A. Stevenson, junior, exhibited a collection of mosses from the Greater Cumbrae, arranged and named by the late Roger Hennedy, formerly lecturer in Botany in Anderson's College. Mr. R. Turner, vice-president, then read a paper on the "Cadzow Herd of White Cattle."

THE LEEDS NATURALISTS' CLUB AND SCIENTIFIC ASSOCIATION.—At the meeting on the 3rd inst., when Mr. G. Hainsworth presided, Mr. W. Clapham exhibited and explained the construction and mode of using several ingenious microscopical appliances he had made. He showed that in place of the more costly "spot lens" a very efficient substitute may be made from an artificial fish eye, which may be mounted in a tube to fit under the stage of the microscope. A very handy section-cutter or microtome was shown and explained. This consisted of the usual brass disc with a hole in the centre communicating with a short tube beneath, in which the object to be sectionised is placed, and up which it is pushed by a screw arrangement. Mr. Clapham showed that by means of a very simple yet perfectly efficient indicator, it was possible to produce sections of any required degree of tenuity down to the five-hundredth of an inch. Another section-cutter, made on the principle of the Cambridge rocking microtome, awakened considerable interest in the members, not only beause of its very evident "home-made" construction, but also, and chiefly, that by such rough means it is possible to cut sections of properly prepared substances so thin as less than the three-thousandth of an inch. Altogether a very pleasant and profitable hour was spent in the examination and discussion of Mr. Clapham's ingenious contrivances. The remainder of the evening was devoted to a number of interesting plants recently collected at and near Seascale, Cumberland, by Mrs. Stringer. Mr. W. Kirkby called attention to some special features of some of the plants, noticing particularly the sawwort (*Serratula tinctoria*), of which he gave the following note from Smith's "British Flora":—"This plant gives a yellow colour to wool, for which purpose Linnæus says it is much used in Sweden. Haller records, on the authority of some foreign writers, that the above colour, fixed by means of alum, is both beautiful and permanent, and with the addition of blue, makes a better green than either *Reseda luteola* or *Genista tinctoria* for dyeing wool or silk."

PHYSICAL SOCIETY OF GLASGOW UNIVERSITY.—The opening meeting for this session of the above society was held last Friday in the Natural Philosophy Class-room, when Mr. Maclean, M.A., president, delivered an address on "Electric Hypotheses." The lecturer discussed at some length the two-fluid theory, first propounded in 1733 by Du Faye, but improved and extended by Symmer in 1759; the one-fluid theory, first put forward by Dr., afterwards Sir William Watson, of England, and Dr. Benjamin Franklin, of Philadelphia; also the ingenious theory of Æpinus, of Germany, and Cavendish, of England. A summary of Faraday's views concerning the distribution of electric forces, as well as a brief *resumé* of the modern views of electricity, concluded the address.

RAMIE.—The subject of the utilisation of the China grass plant, also known under the names of rhea or ramie, has occupied attention for the last 50 years. It is a valuable textile plant, easy of cultivation, and presenting a vast and appropriate field for enterprise for planters in most tropical countries. The only obstacle to the development of an extensive trade in this product has been the want of suitable means for decorticating the plant. The Indian Government in 1869 offered the large sum of £5,000 for the best machine for extracting the fibre of ramie in a green state. No machine has fully answered the purpose, and hence at the present time, in view of the wonderful properties of ramie fibre, the subject is regarded as of the highest importance. It is followed both in this country and in the colonies with the keenest interest. As affecting India the question is of national significance, for the plant could be cultivated over vast areas and, with suitable machinery, be made to yield enormous profits. The French Ministry of Agriculture has taken up the subject, and at trials to be held at Paris on the 25th inst. it offered prizes of the value of 6,000 f. for any process or machine that would extract ramie fibre in commercial quantities. Mr. D. Morris, F.L.S., Assistant Director of the Royal Gardens, Kew, was appointed to represent this country at the trials, and to prepare a summary of the results for the information of persons interested in the subject in India and the colonies.

SALES.

The Charge for Advertisements in this Column is Sixpence for the first sixteen words, and Sixpence for every succeeding eight words.

Advertisements for this Column should be received by first post on Tuesday to insure insertion in the following number.

For sale, Brotherhood 3-cylinder Engine, 6 in. by 7 in., £7. (London).—Address, S., 45, Clarendon Road, Southsea.

For sale, double Launch Engine, by Plenty, 5½ in. by 5 in. £20.—S., 45, Clarendon Road, Southsea.

Greenhouse Stoves, portable, require no chimney, no fixing, cheap, and effective.—PETERS, BARTSCH, AND CO., Derby.

A number of Microscope Objectives, Opera and Field Glasses, Thermometers, for sale cheap.—List on application to A. DANCER, 3, Monton Street, Greenheys, Manchester.

Set 50, coloured Photographic Lantern Slides of London, 6d. each, sample 9d.—5, Hanover Buildings, Southampton.

Field Glass, by Steward, Strand, nearly new, cost 90s., bargain, 35s.—HOLMES, 13, Hollis Street, Leeds.

Proctor's "Star Atlas," and "Universe of Stars," 8s. free.—R. ROWLEY, 45, Camden Street, Derby.

Astronomical Telescope, 3¼ by Wray, 4 powers, finder, tripod stand, 240s. Cost £25.—GOAMAN, Bridgeland, Bideford.

Amateur Mechanics supplied with Lathes, Drilling, Planing Machines, Castings, etc. Cash, or easy payments.—Britannia Company, 100, Houndsditch, London.

Britannia Co. *Bona-fide* makers of 300 varieties of lathes, and other engineers' tools. Prize medals. Makers to the British Government.

Wanted, by two experienced Mechanics, Model Work to do at home (Mechanical or Electrical). Specialities and ideas worked out to drawings, scale, or size. Good workmanship guaranteed. Moderate terms.—P. R., 40, Westbury Street, S.W.

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Amalgamating Brushes, Scratch-brushes, Polishing Sand, Calico Mops, Rouge and Crocus Compositions, Nickel Salts and Anodes.—HENRIC, 234, Great Colmore Street, Birmingham.

Do your own Electro Plating and Gilding. System inexpensive. Particulars one stamp.—PERKS, 47, Alexandra Road, Richmond, Surrey.

Steel Name Stamps, 3d. per letter. Figures (set), 2s. 4d. Post free.—F. BALDWIN, Tuffley, Gloucester.

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Minerals, Fossils, Cretaceous, Liassic, Carboniferous, Silurian. 12 named specimens, 2s. 6d. free—CHAS. WARDINGLEY, Blackwood Crescent, Edinburgh.

Mica or Talc cut for all purposes. Mica chimneys, Mica covers, etc.—C. JOHNSON, 87, New Oxford Street, W.C.

EXCHANGES.

Exchange Notices will be inserted in this Column at the rate of Sixpence for the first twenty-four words, and Threepence for every succeeding eight words.

Advertisements for this Column should be received by first post on Tuesday to insure insertion in the following number.

Grand pair of coupled high-class model Beam Engines, bright and complete, fitted with pumps, governors, throttle valve, made regardless of cost by Lord Scarsdale's engineer, and made for work as well as show. Bargain. Half cash, half exchange.—295, St. Philip's Road, Sheffield.

New powerful Microscope, case, tongues, object-glass. Exchange for 3 in. Electric bell, new, or offers.—JOHN COLLINGE, John Street, off Cross Street, Middleton, near Manchester.

100 Geological Specimens, named. Exchange, 10s. Approval.—HOLDEN, Hoyland Nether, Barnsley.

SELECTED BOOKS.

Handbook of the Amaryllideæ. Including the Alstrœmerieæ and Agaveæ. By J. G. Baker, F.R.S., F.L.S., First Assistant in the Herbarium of the Royal Gardens, Kew. London: Bell and Co. Price 5s.

Electro-Plating. A Practical Handbook on the Deposition of Copper, Silver, Nickel, Gold, Aluminium, Brass, Platinum, etc., with descriptions of the Chemicals, Materials, Batteries, and Dynamo Machines used in the Art. By J. W. Urquhart, C.E. Second Edition. London: Crosby, Lockwood and Sons. Price 5s.

A Text-Book on Steam and Steam Engines. For the Use of Students Preparing for Competitive Examinations. By A. Jamieson, C.E., F.R.S.E., Prof. of Engineering, Glasgow Technical College. With 200 illustrations and four folding plates. Third Edition. London: Charles Griffin and Co. Price 7s. 6d.

NOTICES.

The Title Page and Index to Vol. I., now ready, price 3d.

Binding Cases for Vol. I., price 2s. each.

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Vol. I., bound in cloth, with Title Page and Index, 9s. 6d. —by post 10s.

The Back Numbers of SCIENTIFIC NEWS can be obtained from all Booksellers and Newsagents, or direct from the Publisher, 138, Fleet-street, London, E.C. Price 3d. each, or by post 3½d.

METEOROLOGICAL RETURNS

for the ten weeks ending on Monday, Sept. 17th, 1888. Specially prepared for SCIENTIFIC NEWS from official reports.

	Mean Temperature.	Rainfall.	Duration of Sunshine.
Scotland, East	53·7 degs., being 2·7 degs. below average.	6·2 ins., being 1·0 ins. below average.	300 hrs., being 58 hrs. below average
England, N.E.	55·0 ,, ,, 2·8 ,, ,, ,,	8·0 ,, ,, 1·8 ,, above ,,	260 ,, ,, 68 ,, ,, ,,
England, East	57·2 ,, ,, 3·4 ,, ,, ,,	7·3 ,, ,, 1·7 ,, ,, ,,	301 ,, ,, 83 ,, ,, ,,
Midlands ...	56·4 ,, ,, 3·6 ,, ,, ,,	6·9 ,, ,, 0·4 ,, ,, ,,	307 ,, ,, 46 ,, ,, ,,
England, South	58·1 ,, ,, 2·7 ,, ,, ,,	6·0 ,, ,, 0·6 ,, ,, ,,	328 ,, ,, 67 ,, ,, ,,
Scotland, West	54·7 ,, ,, 1·7 ,, ,, ,,	8·9 ,, ,, 1·0 ,, below ,,	302 ,, ,, 56 ,, ,, ,,
England, N.W.	55·9 ,, ,, 3·2 ,, ,, ,,	8·8 ,, ,, 1·0 ,, above ,,	295 ,, ,, 54 ,, ,, ,,
England, S.W.	56·5 ,, ,, 3·1 ,, ,, ,,	8·5 ,, ,, 0·1 ,, below ,,	374 ,, ,, 59 ,, ,, ,,
Ireland, North	55 9 ,, ,, 2·4 ,, ,, ,,	8·7 ,, ,, 0·9 ,, above ,,	268 ,, ,, 27 ,, ,, ,,
Ireland, South	56·5 ,, ,, 2·3 ,, ,, ,,	7·1 ,, ,, 0·6 ,, below ,,	356 ,, ,, 6 ,, above ,,
The Kingdom...	56·0 ,, ,, 2·8 ,, ,, ,,	7·6 ,, 0·4 ,, above ,,	309 ,, ,, 51 ,, below ,,

During the last week of above period the sunshine value for the kingdom was higher than any previous week since the week ending on May 28th last.

Scientific News

FOR GENERAL READERS.

VOL. II. | OCTOBER 5, 1888. | No. 134.

CONTENTS.

SCIENTIFIC TABLE TALK.

By W. Mattieu Williams, F.R.A.S., F.C.S.

In my last I discussed the series of changes which occur when a thin, filmy substance, such as a leaf or a dead butterfly falls upon a glacier of moderate slope, culminating in the complete perforation of the glacier down to its base by a *trou de cascade.*

The reader may have noted that I carefully specified a supply of *clear* water in the rill flowing into the baignoire. But the water of these glacier rills is not always clear, not usually clear, especially if it flows down the slope of the moraine ridge. On the Unteraar glacier, with its great medial backbone ridge of ice, rising as much as eighty feet above the general level, and coated with rock debris, all the rills that flow from this source carry with them more or less of the sand that results from the continuous disintegration of the rock fragments subjected to a succession of freezing nights and scorching days, such succession being one of the peculiarities of glacier climate to which many glacial phenomena are due.

One of these rills flowing during the summer daytime down the moraine slope into a baignoire and carrying with it the particles of rock deposits them at the bottom of the basin, where they accumulate. The effect of such a covering of the concavity is easily understood. It must put a stop to all further excavation of that portion of the basin which is so protected. The warmer sinking water can no longer continue scooping the bottom, though it may act on the sides. But the general surface of the glacier all around the basin is lowering daily. Supposing the baignoire to be five feet deep when this protection of the bottom begins to be efficient, and that the summer ablation proceeds at an average rate of two inches daily, what will happen at the end of thirty days?

It is evident that the deposit of sand or gravel will now become level with the surface of the surrounding ice, and its quantity will be considerable, as the deposition was continued during the thirty days. We shall thus have a pocket of sand of respectable depth imbedded in the glacier. But the sun goes on thawing the general surface, while that forming the bottom and sides of the sand pocket is protected. Thus the pocket or basin full of sand will presently be raised with its rim above the general level; it will stand upon a pedestal ring of ice. The sun, however, will not spare this pedestal, will thaw its sides and thus undermine the edges of the basin. This undermining will cause some of the sand to trickle over. This will coat the sloping sides of the pedestal and thus protect it.

It is evident that the supply of such protection to the sloping slides will slightly diminish the diameter of the basin itself; its own edge will become somewhat thawed all round. This action will be repeated daily, and as the surrounding surface of the ice continually thaws down lower and lower, the outspread of the protected base increases, and the summit basin diminishes in diameter by the thawing of its edges, until at last it contracts to a mere point, and thus a cone is formed which, as Agassiz says, appears so like a loose heap of rubbish that at first acquaintance one can scarcely resist the temptation to overthrow it with the foot or a stick, but in attempting to do so no little astonishment is excited by its firmness, which is explained on brushing off the surface sand, when a cone of clear ice, continuous with the bulk of the glacier, is revealed.

Schuttkegel (rubbish cones) is the name they have received from the mountaineers, and this is adopted by Agassiz, who refers to the fact that they were in 1840 practically unknown to science, though so interesting in their growth, and supplying, like the glacier tables, such clear demonstration of the surface thawing down of glaciers. They abound on the Zermatt and Unteraar glaciers, but are rare on other glaciers for the reasons already stated in reference to glacier tables.

They are not ordinary cones of circular (horizontal) section, but are all elliptical, the longer axis of the ellipse lying in the meridian of the place, and the southern slope of the cone steeper than the northern. The reasons for this I have already explained in connection with the glacier tables, meridian holes, and baignoires. Those that I saw varied from about one to three feet in height. Agassiz has found them ranging from a few inches in height to six and ten feet across at the base, and four to five feet high.

These are the monuments of the dead butterflies to which I first referred. Some readers may imagine that the idea of butterfly origin is rather fanciful, but such is not the case. A thin film is demanded—a leaf will do—but trees do not grow on glaciers, and the leaves that are carried there by the wind arrive at the wrong time—viz., in the autumn, when they are presently buried in the next fall of snow, and are decomposed before the next summer; but the butterfly is soaring just at the right season, and sometimes, aided by the wind, even crosses high mountain ranges alive, but more commonly alights and dies when above the snow-line or over glaciers.

In the course of our exploration we were conducted to a "crevasse" about three feet wide, on one wall of which some steps were cut in the ice. Descending these we arrived at "Fourc's Salon," or smoking-room. (Fourc was apparently the nick-name of a wag, a laughing philosopher, who took the lead in our excursion. If I am not mistaken, his proper name was M. Desor.) This salon was a cubical chamber, excavated in the ice at a considerable depth below the surface, and therefore was illuminated by the light which passed through its ultramarine roof and walls. The effect was very beautiful, resembling that of the blue grotto of Capri.

Here we had opportunity of studying the structure of glacier ice, which is visibly porous when closely examined. Water was slowly percolating downwards through these pores, and crawling in them were small shining creatures which, from lack of entomological knowledge, I was unable to identify; but I find that in my diary they are likened to the spring-tail lepisma that I had collected on the surface of pools in Battersea fields, in order to mount their scales as test objects for the microscope. I find now that this was not far from the truth, having just met with a foot-note on page 52 of "Untersuchen über der Gletscher," in which they are described as the *Podura nivalis* of Geer, or closely allied thereto. Their active existence in the midst of the ice proves that some kind of food must exist even in this unpromising habitat. I am very glad to have found this note by Agassiz, having seen no other notice of these ice-dwellers, and expecting to find myself in the position of an observer of the sea serpent, had I described them only from my own recollection of this single observation.

My present object in selecting this subject for Table Talk is to bring forward certain curiosities of glacial phenomena which have somehow been overlooked. One may read through a thick book like Geikie's "Great Ice Age," without finding a word about them. It is true that this is mainly devoted to geological agencies, but even in books on modern glacier phenomena they are scarcely noticed. Having done this, I leave the subject for the present, as my readers may have had enough of it.

Discovery of Ancient Relics at Kilmarnock.—A short time ago the workmen, in preparing the ground for the erection of a house in Tichfield Street, came upon an ancient urn, containing arrow heads, etc. Recently the president of the Glenfield Ramblers found a stone gouge near the place where an old coffin was got some seventy years ago. This gouge is made of serpentine rock, and is of fine appearance. It is 4 inches long, 3 inches wide, and curved at its cutting edges. According to authorities, it is not an Ayrshire stone. The thin edge has evidently been ground to a considerable degree of sharpness, and was probably used in gouging out the interior of an ancient canoe. It is intended that these ancient relics shall find a resting-place in the Burns' Monument Museum.

THE VOLCANIC ERUPTION IN JAPAN.

(Continued from page 334.)

A LITTLE table-land, below us on the left, marked the site of the medicinal hot springs of Shimo-no-yu, where a number of invalid visitors, forty or more in number, had been taking the waters, and now springs and visitors are buried under twenty feet of mud.

To find a spot sufficiently free from mud for us to sit down and open the tiffin-basket, we had to descend a few hundred yards. Then we returned to the same spot and climbed cautiously over the edge and down the slope, our object being to reach the top of the mud-wall I have described as being on our right, and from behind which the steam was rising from the crater itself. The mud was in great cakes and boulders, resting upon the great mass of it beneath—exactly, in fact, like a choppy sea suddenly solidified. The walking, therefore, or rather scrambling, was difficult, and the surface of the mud treacherous. By chance, when we had descended far enough in a straight line and turned off to the right to climb to the wall of the crater, two of us happened to be in advance of the rest. Slowly and cautiously we approached the edge, testing the masses of mud before us at every step. At last, side by side, and on our hands and knees, we looked over. The mud-wall upon the edge of which we stood, sank straight down out of sight into the depths of the abyss, and actually shelved in underneath us, so that we were suspended over the seething crater upon no support stronger than overhanging mud, neither solid nor tenacious. Needless to say that after a single brief look we beat a gingerly but hasty retreat. And none too soon, for there between us and the rest of the party was a long crack several inches wide. But that minute's look will never be forgotten by either of us. For a thousand feet the mud precipice rose straight up to our feet; the crater from which it sprang was probably a mile wide; from a dozen half-visible openings the steam was issuing with the noise of a distant waterfall, while the chief orifice of the crater was altogether hidden by the cloud of steam above it; and, whenever the vapour was dissipated for a moment, we could see the liquid mud at the bottom, apparently still seething in great disturbance and commotion. The colossal scale of it all, the more than Alpine precipice, the ocean of mud, the buried village, the heat, the steam, the noise, the attempt to picture in imagination the scene when the earth had been thus burst and riven and scattered and convulsed, and the solid land had melted and flowed out as the sea—all these combined to produce an impression of awe and stupefaction which nothing subsequent can ever efface, and with which no previous experiences of life afford the slightest comparison.

We were the first foreigners to make thus a rough but fairly complete examination of the scene of the eruption, and when we started for our long walk home later in the afternoon, we were in a position to say with some confidence just what had happened. These conclusions, we may say here, were confirmed and corrected by the narratives of the survivors, whom we interviewed the next day amongst the ruins of the villages at the foot of the mountain on the side opposite to that we had ascended. The main facts of the eruption are these: At the point of the manifestation of volcanic activity, the mountain range consists of three peaks, which are often spoken of together as Bandai-san, but consists properly of Bandai-san, 5,800 feet, a somewhat smaller mountain known as Sho-Bandai-san, and a third, larger again, called Nekomatadake. The eruption had taken place in the smaller central one of the three, and Sho-Bandai-san has disappeared from the face of the earth. The explosion was caused by steam; there was neither fire nor lava of any kind—it was, in fact, neither more nor less than a colossal boiler explosion. The whole top and one side of Sho-Bandai-san had been blown into the air in a lateral direction, and the earth of the mountain was converted by the escaping steam at the moment of the explosion into boiling mud, part of which was projected into the air to fall a long distance off and then take the form of an overflowing river, and part of which rushed down with inconceivable speed and resistless force, and poured over the face of the country to a depth varying from twenty to a hundred and fifty feet. Thirty square miles of country were devastated and practically buried by this eruption, a fact which places it, as I said, among the most stupendous on record.

Part of the Crater, showing Masses of Rock resting on Mud.

Importation of Scientific Books and Apparatus into the United States.—At the late meeting of the American Association for the Advancement of Science, a petition to Congress was adopted to place on the free import-list books pertaining to the physical, natural, and medical sciences and apparatus intended for the purposes of scientific research or of education.

THE ANCIENT INHABITANTS OF THE CANARY ISLANDS.

A Paper read by Mr. J. Harris Stone, M.A., before the Anthropological Section of the British Association.

About the time when printing was being introduced into England an old-time race of ancient people was rapidly and cruelly being exterminated. "The world forgetting, by the world forgot," they had lived in seclusion till then, the date of their advent being just as uncertain and ancient as their disappearance from among the races of mankind is precise and modern. In the whole history of the world there is, perhaps, no more remarkable fact than that at that late date of the Christian era when civilisation had so far advanced as to include in its scope amongst other signs of refinement, gunpowder and printing, there existed close to Europe, on islands in the Atlantic, remnants of peoples of the Stone, or may be even earlier ages. Yet such was the case. Whether or not the ancient inhabitants of the Canary Islands belonged to that extremely vague and misty period the "Stone" age, is a problem which may be left to others; but beyond all doubt as late in time as 1402 there lived in those islands a race very far removed in the upward scale from what we know as savage, a race presenting to us features of intense interest, a race till then virtually uncontaminated by external influences. These are statements which it is likely no student and traveller will deny. Traveller is thus purposely coupled with student, because for several reasons it seems advisable that besides a knowledge of their past history, the investigator should possess a personal acquaintance with each of the islands in order to intelligently and impartially treat this subject. Several grotesque and ridiculous theories and statements have seen the light about the Canaries and their ancient inhabitants, which would certainly not have been put forward had their authors ever been through the islands, and had noticed the present inhabitants, the configuration of the country, and the remains of the old inhabitants which are to be seen *in situ*. In the case of nearly all the writers on the Canary Islands, with one or two notable exceptions, a partial knowledge of the islands has proved to be misleading.

For example, Bory de St. Vincent, in a thick quarto volume, published in 1803, amongst other obvious blunders, states that the old inhabitants, whom he comprehensively and erroneously calls Guanches, buried their dead in pyramids destined to endure, like those of Egypt, for a number of centuries, and that the builders of the magnificent Egyptian structures were no more expert in architecture than were the Guanches. Now the student soon discovers that Bory de St. Vincent's large work is entirely a compilation from that of Viera, coupled with the result of *one night's stay* at Santa Cruz, in Tenerife. The pyramids, so strong, so lasting, so grand in architecture, have been visited by me. To lean against them would disarrange the loose stones of which they are composed, and they are about three or four feet in height. The epithet pyramidal might be applied to the rough and ready way in which the stones were thrown on the tombs in question, and some such rumour reaching the too credulous author doubtless accounts for his remarkable statement.

The same author also thinks that the Purpurariæ were Madeira and Porto Santo. The presence of orchil and inhabitants in Lanzarote and Fuerteventura, and their absence at that period in Madeira and Porto Santo, should have prevented Bory de St. Vincent falling into this error. Scant courtesy has always been paid to these islands by travellers.

Ogier, who could never have visited the ancient burial-places of the race, makes the following astonishing statement: "The Guanches had a temple which was long believed to be a tomb. It is a kind of stone pyramid in Gran Canaria, with respect to which we have no information of any kind. In this building, and in the shape of their temple, we can trace a similarity to the ancient pyramidal and circular constructions of Ancient Egypt and Karnac in Brittany."

Similarly Humboldt's description of Tenerife is very inaccurate and misleading. His long account is founded on a *three days' stay only* in the island, added to what he heard and had read.

Still more recently, the elaborate account of the whistling language of Gomera does credit to the inventive faculty of its German author, but it is not a contribution to our knowledge of that island.

I wish in the first place to show that this interesting people, up to the time of the conquest of the islands (1402 to 1496), incredible as it may seem, were ignorant of the use of metals.

In the collections of their remains which can be seen in the islands themselves there are no signs that metals were used. In the tombs and caves which I have visited no signs of metal remains were apparent, and history supports this conclusion.

In a narrative emanating from certain Florentine merchants (1341), and recorded by Boccaccio, we learn that the inhabitants of Canary "were shown some gold and silver money, but they were quite ignorant of the use of it, and they knew as little of any kind of spices. Rings of gold and vases of carved work, swords and sabres, were shown to them; but they seemed never to have seen such things and did not know how to use them."

Again, Azurara (1443) remarks that "their only weapons were a short club and the stones with which their country abounded; they made no account of the precious metals, but set a high value on iron which they worked with stones, and made into fishing-hooks," this was, of course, after they had obtained that metal from the conquerors, "they even used stones for shaving;" and further, that the people of Palma "fought with spears like the men of Tenerife, but pointed them with sharp horn instead of iron." Plenty of these spears are to be seen in the islands. Cadamosto, who wrote in 1455, during the conquest, says of the natives of Tenerife, "Their weapons were stones and javelins, pointed with sharpened horn instead of iron, and sometimes the wood itself hardened by fire, till it was as hard as iron." It must be remembered, however, that Cadamosto only visited Gomera and Hierro. His other information must therefore have been hearsay. The narrators of the conquest, in several passages in the course of their rather rambling narrative, clearly endorse the fact that the use of iron was unknown. When they arrived at Gran Canaria they induced some natives to come on board and exchange figs and dragons' blood for "fishing-hooks, old iron, and little knives," while with great *naivete* they continue, "The dragon's blood was well worth two hundred ducats, while what was given in exchange was hardly worth two francs." Then again, "The infidels have no armour nor any knowledge of warfare; they are not, therefore, to be dreaded like other nations." Again, of the isle of Hierro they say, "The men use long lances without iron points, for they have no iron nor any other metal;" and again, of the Canarios, "These people have no other weapons" (than stones), "and, believe me, they can throw and handle a stone much better than a Christian can." And the natives of Fuerteventura "had no armour, and were only clothed in goatskins and leather and could only retaliate with stones and wooden lances untipped with iron, although they did a good deal of mischief."

Many will join issue upon the assertion that up to the beginning of the conquest of the islands in 1402 the inhabitants had lived, to all intents and purposes, unknown to the world, and therefore unacquainted with the civilisation of the time, though the highest civilisation of that day was, it may be said, close at their doors; still, it may be maintained that the proposition is right, and that for three reasons. The recorded voyages before 1402 support this view, as do the remains of the ancient inhabitants which can be seen to-day, and also the physiognomy of the islands themselves—a factor the importance of which is considerable. Even during the conquest in 1446 we find an independent voyager who went there, Dinisianez da Gran, writing: "In fight they used no weapons but sticks and stones; their clothing upwards was skins, the lower part a covering made of palm leaves of divers colours. They took off their beards with sharp stone?"

Concerning the *very ancient* inhabitants of the Canary Islands we know nothing. They were peopled then by the souls of the blessed. The ancient poets delighted to dwell on those Elysian Fields, the resting-place of the happy departed spirits far beyond the entrance to the Mediterranean, on the banks of the river Oceanus, or on islands in its midst.

Homer says that, "there the life of mortals is easy; there is no snow, nor winter, nor much rain, but ocean is ever sending up the shrilly breathing breezes of Zepherus to refresh man." Hesiod and Pindar describe them under the name of the Fortunate Isles, but we learn next to nothing of their corporeal inhabitants. The earliest mention of the islands, not entirely partaking of the romantic halo so delightfully woven round them by Homer and other ancient authors, is in the treatise "De Mirabilis" about the year 250 B.C. The account there given, as also that by Diodorus, are no doubt taken from the historian Timæus, his authority being the Greek navigator Pytheas and the travellers' tales of Punic and other sailors. But it were only right to say that these accounts may equally apply to the Madeira group. I rather incline to the conclusion that, at any rate, the two easterly islands of the Canary group (Fuerteventura and Lanzarote) were included, because primitive sailors would come across them by coasting, the nearest island being only sixty miles distant from the west coast of Africa. For the same reason I still more strongly think that Lanzarote and Fuerteventura are alluded to in "Plutarch's Life of Sertorius." That general, Plutarch says, "crossed the Straits of Gades, and keeping to the right, landed a little above the mouth of the river Bœtis (Guadalquiver), which, running through a large track to discharge itself in the Atlantic Ocean, gives name to all that part of Spain through which it passes" (*Bœtica*, now *Andalusia*). "There he found some mariners lately arrived from the Atlantic Islands. These are two in number" (probably Lanzarote and Fuerteventura). "separated only by a narrow channel, and are at the distance of four hundred leagues from the African coast. They are called the Fortunate Islands. Rain seldom falls there, and when it does it falls moderately; but they generally have soft breezes, which scatter such rich dews that the soil is not only good for sowing and planting, but spontaneously produces the most excellent fruits, and those in such abundance, that the inhabitants have nothing more to do than to indulge themselves in the enjoyment of ease.* The air is always pleasant and salubrious, through the happy temperature of the seasons, and their insensible transition into each other; for the north and east winds which blow from our continent, in the immense track they have to pass, are dissipated and lost; while the sea winds, that is, the south and the west, bring with them from the ocean slight and gentle showers, which imperceptibly scatter plenty on their plains. So that it is generally believed, even among the barbarians, that these are the Elysian Fields, and the seats of the blessed, which Homer has described in the charms of verse."

"Sertorius hearing these wonders, conceived a strong desire to fix himself in these islands, where he might live in perfect tranquillity at a distance from the evils of tyranny and war."

This account, which bears internal evidence of relating to the Canary Islands, is the least hazy that we know of up to the date 82 B.C.

Pliny gives us a vague itinerary, drawn up by Statius Sebosus, about 40 B.C., in which, under the name of the Hesperides, five islands of the Canary Group are clearly mentioned.

Unfortunately for the Anthropological Section of the British Association, these old-world sailors, like their successors in more modern times, were not literary, and even if any of them did possess habits of scientific observation, they were not educated enough to commit their observations to writing. Hence our knowledge of the inhabitants of the islands in these times is most misty and doubtful.

King Juba II. sent out an expedition specially in

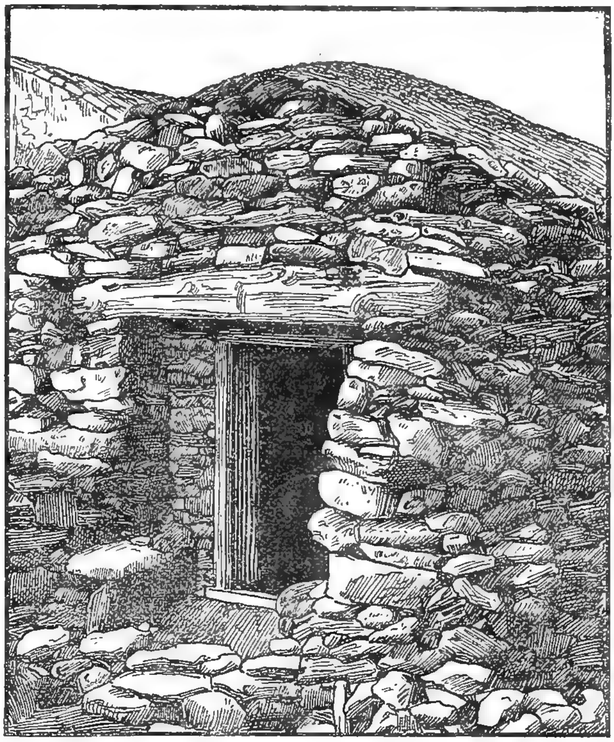


FIG. 1.—THE ONLY GUANCHE HOUSE IN THE ARCHIPELAOG, SAN BARTOLOME, TIRAJANA.

search of the Insulæ Fortunatæ, and finding the Canaries, named them from their characteristics thus: Ombrios (Palma), Junonia (Gomera), Nivaria (Tenerife), Capraria (Hierro), Canaria (Gran Canaria), while the name Purpurariæ was given to the two islands Lanzarote and Fuerteventura. From this time it might be thought we should have begun to learn something definite concerning the islands and their inhabitants. Owing to the destruction of the Roman Empire, and the pall of inertness and ignorance which settled over the civilized world, this gleam of knowledge concerning the islands faded away, and for no less than thirteen centuries they were practically lost, less being known and thought about them than in the days of Homer. In his time an interest in them was taken, even though that interest was of a romantic or semi-religious character, but now for thirteen centuries

* In a letter written in November, 1814, and published in Vol. I. of the *Pocket Magazine*, the writer, who dates from Fuerteventura, says, "There is a tradition in the island, of nearly three hundred years date, which indicates that the barren mountains were then covered with trees, like those of Tenerife and Canary."

no interest of any kind whatever was felt as to their fate. They seem to have completely faded away from men's thoughts.

The Portuguese were probably the re-discoverers. About 1341 the spirit of enterprise began once again to animate men's breasts, and the poet Boccaccio sets forth an account of a voyage made to the Canaries in that year under the direction of the King of Portugal. From this narrative we learn that the voyagers landed probably on Fuerteventura, but "they did not dare to penetrate far into the country." At Gran Canaria they saw apparently little of the inhabitants, for they say some of the natives "were covered with goats' skins coloured yellow and red, and, as far as could be seen from a distance," showing their intercourse with them was slight, the skins were fine and soft, and tolerably well sewn together with the intestines of animals. To judge from their gestures, they seemed to have a prince. Their language, however, was soft, and their pronunciation rapid and animated like Italian. The sailors went on probably to Gomera, but "ventured but a very little way into the country." They also sailed round Tenerife, but "did not dare to land."

From this important account, we plainly gather that the natives were anything but savage; that the islanders had no means of intercommunication, for they knew not the use of boats; and probably that the languages or dialects of the islands were so different that the natives of one could not understand the natives of another; still, the languages had some affinity to one another; that the sailors found the islanders anything but rich, for they "hardly covered the expenses of the voyage;" and that, finally, their intercourse with the islands when they did land was so slight and their journeys in those islands—if they left the shore, which may be doubted—so unimportant that their advent was scarcely felt. They were amongst the islanders altogether only some fifteen or sixteen weeks. It is probable that the Portuguese visited the islands on perhaps one or two occasions earlier than 1341, but no detailed accounts of the voyages have been discovered, and it may reasonably be supposed that they partook of the same superficial character as that to which allusion has been made. From this time to the commencement of the final conquest, which began in 1402 by Jean de Bethencourt, we know nothing of the ancient inhabitants of the islands. They remained as before, a simple, gentle people, unknown to the world at large, pursuing their usual avocations and having everything they wanted in their self-contained islands. Occasional expeditions from Europe, doubtless at rare intervals, reached their shores and kidnapped natives. Vessels manned by Genoese, Castilians, or Florentinos, corsairs, and adventurers in search of any kind of portable prey, whether dead or living, may have ravaged their coasts. But the natives at the approach of strangers would retire to their mountain-strongholds and fastnesses, where a handful could make an effective stand against a large number of assailants. The precipitous and rocky nature of the shores of most of the islands, the absence of natural harbours and anchorage ground, would have rendered, in those days, the coasts anything but favourable for vessels. Then again the natives never were a sea-going or sea-loving race. With most early races the sea was held to be evil and not to be trusted. They did not live much by the shores. Their great settlements were in the interior, in most inaccessible places. Hence the foreign maurauder would see little near the shore to tempt him to pursue his thieving propensity, or to again pay the islands a visit. And, besides, even the most successful adventurer obtained, in human cattle and goods, hardly sufficient to repay his outlay. Most of these spasmodic advents of civilisation must have been made at a loss. When the foreigners did meet the natives arm to arm, the latter could always give a good account of themselves; for they were lofty of stature, robust of limb, and of wonderfully healthy constitutions. Altogether it may be well imagined that the handful of men from a casual ship would think twice before engaging in hostilities with this vigorous race. The mere fact that it took the Spaniards from 1402 to 1496, and a vast amount of hard work and endurance before they were able to complete the conquest, is mutely eloquent of the courage of the natives. The configuration of the ground of the Canaries shows that it is almost everywhere admirably adapted to help the efforts of defenders knowing the country well. Even at the present day, a great portion of the islands is well nigh impassable, and the entrances to them difficult. In the narrative of the conquest we are continually reminded of this. Hierro "is very difficult of access, for it has no good port or entrance;" "the others fled and betook themselves to the mountains;" "the country is so inaccessible;" "they found it necessary to take off their shoes to pass over the slabs of marble, which were so smooth and slippery that they could only cross them on hands and feet, and even those who were behind had to hold the ends of their lances for the foremost to push their feet against, and they, when safely over, in their turn pulled the hindmost after them." This place I travelled over on a camel's back whose soft pads safely grasped the stones of the rough path now hewn, where on foot there might have been some danger of a fall over the precipice. "The forces from Seville, being unaccustomed to such rough ways, were greatly incommoded and harassed by the natives, who, being very agile, leaped from rock to rock with great ease (having been used to the exercise from their infancy), and galled the Spaniards in those narrow passes in such a manner as obliged them to retreat." And again Galindo succinctly remarks: "All the Canary Islands, except Lancerota and Fuerteventuras" (but he could not have known those islands well, or he would not thus signally except them) "are so full of deep and narrow vallies, or gullies, high rugged mountains and narrow difficult passes, that a body of men cannot march into any of them the distance of a league from the shore, before they come to places where an hundred men may very easily baffle the efforts of a thousand. This being the case, where could shipping enough be found to transport a sufficient number of troops to subdue such a people, and in a country so strongly fortified by nature?" And again, in Canaria, when the Spaniards, elated by a late victory, pursued the Canarians to the mountains, they defended themselves so well, by throwing stones and tumbling down loose fragments of rocks upon the enemy, that they obliged them to retreat, with the loss of twenty-five men killed and a great number wounded."

(To be continued.)

EARTHQUAKES.—According to a communication from Mr. W. G. Forster of Zante, there was a subsidence of the sea bed in the Gulf of Corinth, accompanying the earthquake felt in Greece on the 9th inst.

General Notes.

DRIVING BANDS OF CAMELS' HAIR.—It is said that, according to experiments made at the Polytechnic Institute of Munich, belts of camels' hair are superior to those of leather, hemp, etc.; that they work without noise, and are not affected by acids.

THE DESTRUCTION OF THE PHYLLOXERA AND THE HETERODERA SCHACTII.—M. Willot, in a communication to the Academy of Sciences, states these pests may be destroyed by solutions of common salt, though they are capable of resisting morphine, belladonna, atropine, strychnine, and curare.

A TRICYLE WITH SAILS.—The ancient Chinese invention of light carriages driven by the wind is now being successfully applied in Europe to tricycles. In open country, when the wind is favourable, the machine may be propelled even up moderate hills without any exertion on the part of the rider.

TEMPERANCE BEVERAGES.—According to the *Medical Press*, the Board of Inland Revenue have lately been examining so-called "teetotal" drinks, with some startling results. A sample of elderberry syrup contained more than 8 per cent. of proof-spirit; a "non-alcoholic" ginger cordial, more than 10 per cent.; certain "unfermented sherry" yielded 17 per cent.; and a "cowslip wine" no less than 28½ per cent.!

SOME RESULTS OF THE CANAL OF SUEZ.—Among the unforeseen consequences of the opening of the Suez Canal is a change of the climate of Lower Egypt, where rain, previously almost unknown, has become relatively frequent. Another result is less satisfactory; the sharks of the Indian Ocean have found their way into the eastern part of the Mediterranean and the Adriatic. Sea-bathing at the ports of Fiume and Pola is rendered impracticable.

THE DEPTHS OF THE SEA.—In the last report of the hydrographic service of the United States on the soundings effected by the *Albatross* in the Pacific along the coasts of Central America, mention is made of a line passing by 11° 45′ N.L. and 97° 3′ W. Long., where the water has a depth of 4,518 metres, or about the height from the sea-level to the summit of Mount Shastu, in California. Other soundings gave depths of only 90, 95, 104, and 110 metres.

NEW SCIENCE AND ART INSTITUTE.—Sir Charles Forster, M.P. for Walsall, recently opened a new science and art institute which has been built in that town. The ceremony of laying the foundation stone of the new structure formed part of the jubilation celebration last year. The total cost of the building, including furnishing and the fitting up of laboratories, is estimated at £5,500. Towards this, £4,000 was raised by subscriptions, and it was stated that with the Government grant and income derived from other sources the institute would be opened practically free from debt.

THEORETICAL ASTRONOMY.—We learn that Professor Newcomb is engaged on an important work dealing with theoretical astronomy. Its general object is the determination of the form, size, and position of the orbits of all the large planets of the solar system, from the best and most recent observations, and the preparation of entirely new and uniform tables for predicting the future positions of those objects The part of the work now far advanced comprises the four inner planets, Mercury, Venus, the Earth, and Mars, in which fourteen pairs of planets come into play. Twelve of these are completed. There remains but the action of Jupiter on Venus and Mars to be determined. All the observations at Greenwich from 1765 to 1811 have been reduced with modern data, and the work by Dr. Auwers dealing with an earlier period has also been embodied in Professor Newcombe's researches.

THE ENGLISH EXPLORING EXPEDITION IN MOROCCO.—The following telegram despatched from Mogador on September 19th, and transmitted by the Eastern Telegraph Company's cable from Tangier, has been received by the Royal and Royal Geographical Societies:—Left Morocco city August 27th. Driven back from Uricka-valley, but attained object by another route. Made an ascent of main range from Reraya, reaching nearly 13,000 feet. Skirted base of mountains to Imintanut, where we crossed by forced marches into Sous country, through tribes in revolt against Kaid. Nearly besieged in castle of Kaid of the Misgina by Howara in revolt. Succeeded in escaping safely to Agadir. Reached Mogador September 17th. May return to Hana for a few days. Afterwards go north to Fez and Mequinez. Home probably middle of December. Letters first fortnight, Consul, Rabat; afterwards Tangier. Perfect health. Successful beyond expectations.—JOSEPH THOMPSON, HAROLD CRICHTON-BROWNE.

DISCOVERY OF PREHISTORIC REMAINS NEAR BASINGSTOKE.—A shepherd, in the employ of Sir Nelson Rycroft, Bart., was pitching hurdles in a field adjoining Dummer Clump, when the bar came in contact with a large stone, which on being removed was found to have covered two very rudely-formed vessels, of which the under one was pronounced by Dr. S. Andrews, of Basingstoke, to contain human bones, which had undergone incineration. Subsequently another urn was removed of a much coarser character, bearing a band round the base of the rim ornamented with sunken dots, made apparently with a hollow stick. The whole of the vessels are hand-made, and apparently fire-baked, and the larger ones have suffered some damage from the plough, which must have repeatedly passed over them. Subsequently three other vessels, two large and one small, were found. All are of the same slightly baked clay, ornamented with bands. These are sometimes raised and ornamented with the forefinger or thumb of a woman or boy; while, in one case at least, a second band of ornament is formed by the indentations made by the tip of a finger. With one exception, all were placed in the ground bottom upwards, the bottoms themselves being in every case wanting, probably destroyed by the plough, they being only six or eight inches underground, and they were filled with earth, clay, and a few burnt bones. The only exception is the first found, which was upright, and nearly filled with burnt bones only. On it was placed a small vessel of better baked ware.

THE PUBLIC HEALTH.—The Registrar-General's return for the week ending September 22nd shows that the deaths registered during that period in 28 great towns of

England and Wales corresponded to an annual rate of 18·0 per 1,000 of their aggregate population, which is estimated at 9,398,273 persons in the middle of this year. The six healthiest places were Bristol, Huddersfield, Oldham, Brighton, Nottingham, and Wolverhampton. In London 2,463 births and 1,298 deaths were registered. Allowance made for increase of population, the births were 248 and the deaths 109 below the average numbers in the corresponding weeks for the last ten years. The annual death-rate per 1,000 from all causes, which had been 16·0 and 16·2 in the two preceding weeks, declined last week to 15·8, a lower rate than has prevailed in any week since the 3rd of July last. During the 12 weeks ending on Saturday last the death-rate averaged 16·2 per 1,000, and was 3·6 below the mean rate in the corresponding periods of the ten years 1878-87. The 1,298 deaths included 32 from measles, 20 from scarlet fever, 24 from diphtheria, 22 from whooping-cough, 11 from enteric fever, 78 from diarrhœa and dysentery, and 4 from cholera and choleraic diarrhœa. Thus 191 deaths were referred to these diseases, being 39 below the corrected average weekly number. No death from small-pox was registered, the corrected average being 5. In Greater London 3,247 births and 1,629 deaths were registered, corresponding to annual rates of 30·6 and 15·4 per 1,000 of the estimated population. In the Outer Ring 30 deaths from diarrhœa, 8 from diphtheria, and 7 from whooping-cough were registered. The deaths from diarrhœa included 4 in West Ham, 3 in Croydon, 3 in Brentford, and 3 in Walthamstow sub-districts. Of the 8 fatal cases of diphtheria 3 occurred in Edmonton and 2 in West Ham registration districts.

Effects of certain Gases and Vapours upon Health.—In a communication to the Bavarian Academy of Sciences Professor von Pettenkofer expounded the results of some recent investigations on this subject. It appears that the current views as to the quantity of certain gases and vapours which may be safely inhaled are very remote from the truth, and stand in need of rectification. (1) *Hydrochloric acid gas.*—Even 0·1 per thousand of this gas excites in rabbits, cats, etc., great restlessness and increased secretion of saliva, etc.; at 1·5 to 2 parts per thousand difficulty of breathing sets in, with conjunctivitis and opacity of the cornea, and catarrhal pneumonia, which is often fatal. Man is more sensitive to this gas than the lower animals. (2) *Ammonia.*—The action of this gas is similar to that of hydrochloric acid, but less intense. 0·3 per thousand is the point at which injurious action begins, and 0·5 per thousand is the utmost limit which men can bear after long practice. From 2·5 to 4 parts per thousand produce dangerous inflammation of the lungs on exposure for a few hours. (3) *Chlorine.*—Very small quantities (0·01 per thousand) produce irritation in the respiratory organs; 0·015 to 0·03 per thousand produce bronchitis and catarrhal pneumonia. Doses of 0·04 to 0·06 per thousand are dangerous, and 0 6 per thousand is rapidly fatal. (4) *Bromine* acts exactly like chlorine. The statements in books exaggerate the bearable quantities of ammonia, chlorine, and bromine at least one thousand-fold. (5) *Sulphuretted hydrogen.*—The poisonous nature of this gas is well known, but it is commonly supposed more dangerous than chlorine or bromine, which does not hold good. (6) *Sulphuret of carbon.*—Different qualities of this compound vary greatly in their poisonous action; some have very little action. (7) *Aniline* and *nitrobenzol.*—Aniline in the proportion of 0·1 per thousand is dangerous; cats and men are almost equally susceptible; rabbits and guinea-pigs are little affected. Nitrobenzol is not readily introduced into the system through the lungs. Pettenkofer is of opinion that the injurious influence of the above gases and vapours does not depend merely upon local changes in the blood, but upon morbific effects upon the nervous system, and especially the nerve centres. It seems also established that the higher the development of an organism the more susceptible it is to pernicious gases and vapours. Bacteria can tolerate poisonous gases in the air in proportions and for lengths of time which would be instantly fatal to men or to other warm-blooded animals. This is perhaps the reason why man requires in his dwellings a purer air than do the domestic animals.

The "Plastering" of Wines.—Mr. Griffin, United States Consul at Limoges, in a recent report states that since the great reduction in the amount of wines produced in the Bordeaux and Burgundy districts, the inferior wines of the central departments of France are being substituted for them, and chemistry is called in to increase their market value. "Plastering" consists in adding sulphate of lime after the first fermentation or while the wine is in the vat; it is also mixed with the grape-must. The general rule is to give 500 grammes of the "plaster" to the hectolitre of wine, but more usually it is thrown in without weighing. The advantages of the sulphate of lime are said to be increased fermentation and a brighter and more permanent colour in the wines, which will also keep much longer. The objections are that the chemical changes render the wine injurious to health, for it is said that the bi-tartrate of potash contained in wine in its normal state, when brought in contact with the "plaster," forms an acid sulphate of potash, and there is precipitated an insoluble bi-tartrate of lime, varying according to the degree of alcohol. The quantity of sulphate of potash in the wine is increased from five to ten fold by the action of the "plaster." Moreover, in wine treated in this way sulphuric acid is found in a free state, as well as sulphate of magnesia. The effects of the practice on the health of the consumers of the wine so treated were discussed in the Academy of Medicine, and one of the members, M. Marty, has made a report on the subject. As far back as 1857 the doctors in the department of Aveyron found that persons drinking "plastered" wines had an unquenchable thirst and an insupportable dryness of the throat; but different authorities gave different estimates of the effect on health of the consumption of these wines. Hygienic committees reported they were harmless; chemists said they were injurious to health; but M. Marty appears to settle the question from a hygienic point of view. It is an incontestable fact, he says, that "plastered" wines occasion functional troubles and organic injuries; they act as purgatives and caustics in certain cases; but it appears that moderate "plastering" is necessary to the utilisation, preservation, and transportation of certain of the poorer grades of wine, and in such cases it is recommended that the proportion of acid sulphate should not exceed two grammes per litre. As a general conclusion, the Academy is of the unanimous opinion that "plastering" wine is a custom detrimental to health, and advises that the laws against it be rigorously enforced.

SOME PHOTO-MICROGRAPHIC APPARATUS.

ONCE the initial difficulties are overcome, few occupations are more instructive or engrossing than photographing objects through the microscope. An impression exists among people who have not tried it, that photo-micrography is a very difficult branch of the photographic art. This is undoubtedly true when very high powers must be used, but it is not proposed to treat of such matters here, but only to describe a simple apparatus which can be acquired by most people, and which can be successfully used by any person possessing intelligence, a little manipulative skill, and patience.

The advantages of photo-micrography are that there is little or no trouble in getting ready the apparatus; that photographs can be taken either in the daytime or in the evening; that the illuminating power being, if artificial light be used, practically constant in intensity, the variation of the exposure is dependent only on the degree of magnification to be attained and the colour and nature of the object it is desired to photograph, thus eliminating the condition most difficult to determine in making a sunlight exposure, the ever-varying actinic power of daylight.

The absolute necessaries for taking a photograph are, a lamp, a microscope, and a camera with a dark-slide.

The lamp best suited to the purpose is the ordinary microscope lamp, sold by any optician. This lamp has a suitable screen or hood, with an aperture for the emission of the light, and facilities for turning either the flat or the edge of the flame towards the microscope. A vertical adjustment and a condensing lens are also desirable.

The microscope may be of the simplest form, provided a good coarse and fine adjustment be supplied, that it has suitable spring clips to the stage, and that it is so constructed as to allow of the body being brought into a horizontal position. A set of revolving diaphragms beneath the stage is also of great value.

A camera suitable for ordinary landscape photography will meet the requirements of a beginner, though the greater the extension of the camera the better. The only necessary points to observe are, that absolutely no light enters into the camera except that admitted through the objective of the microscope, and that the focussing screen and the dark-slide occupy, when in position, the same plane.

In arranging the apparatus it is advisable to procure a piece of dry, well-seasoned pine or mahogany, 3 ft. 6 in. by 10 in. by $1\frac{1}{4}$ in. thick, which will form a capital base-board.

Place the microscope on it, and bring the body of the microscope into a perfectly horizontal position; then with the greatest accuracy measure the distance from the board to the centre of the tube of the microscope. This will give the height of the optical axis above the base, and it is of great importance to maintain this line perfectly parallel to the base, from the lamp to the focussing screen of the camera. The centre line of the apparatus should also coincide in plan with the centre line of the base-board.

Having determined the position of the microscope, which should be about nine inches clear from the end of the base-board, mark the position of the claw foot of the microscope, and screw on small wood chocks or clamps to hold it in position; the microscope can then be moved from the board and replaced in position as desired. It is well also to fix a supporting block on the base-board, upon which the tube of the microscope should bed when horizontal, thus ensuring the microscope tube being readily brought to the required position.

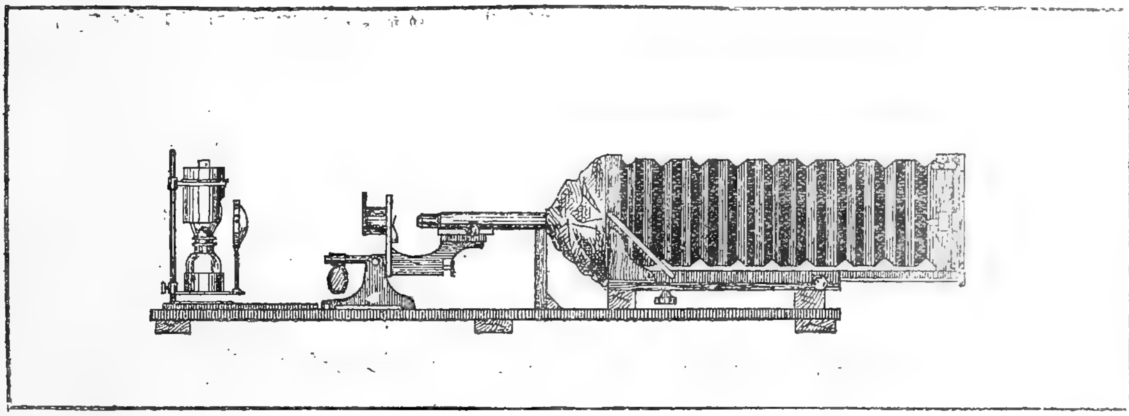


FIG. 1.—SIMPLE PHOTO-MICROGRAPHIC APPARATUS.

A suitable bed for the camera must next be prepared. It will probably be found that the height from the underside of the base of the camera to its axis will differ from that of the microscope, and that the camera will require to be packed up to the requisite height; this is best done in the method shown in fig. 1. A slot, 10 or 12 inches long should be cut in the centre of the supporting board of the camera, through which the tripod clamp screw, usually supplied with a camera will work. This arrangement will allow the camera to be moved up to or away from the eye-piece end of the microscope, and secured in any desired position.

The junction between the camera and microscope is best effected by means of a conical velvet funnel, secured to the body of the microscope by an elastic ring, the other end being passed all round the front of the camera. This allows the adjustment of the microscope to be readily effected, the eye-piece end of the tube working through the lens aperture in the front of the camera.

The lamp must then be centred, and should be secured to the base-board by means of two rebated fillets, between which it should work easily, thus enabling it to be moved towards or away from the microscope at will. The vertical adjustment is usually supplied with the lamps known as " Bocket lamps."

The writer, after many trials, has found that the most suitable illuminant is formed by adding to one pint of Defries' oil one ounce of camphor, and allowing it to dissolve. This gives a brilliant and powerful light, very rich in actinic rays, whilst little or no smell arises from it.

The wick should never be trimmed with scissors, but the charred portion should be rubbed off gently with the finger till it is level with the top of the burner, and all loose threads removed.

One of the most important details in the whole process of taking a photograph through a microscope must now be considered; and unless the points now to be mentioned are carefully kept in view, it is of little use to hope for a sharp negative.

The slightest error in registration between the focussing screen of the camera and the position occupied by the sensitive plate when in the dark-slide will produce lamentable results. This is the more likely to occur when an inner frame or carrier is used to hold the plate in the slide, and the writer, therefore, strongly advocates that the ordinary ground glass screen of the camera be discarded and that the focussing be done on a piece of ground glass fixed in the carrier in the dark-slide, and secured by means of spring clips, in the exact position which the sensitive plate will subsequently occupy. By this method the chances of faulty registration are reduced to a minimum, whilst by drawing out both the shutters of the dark-slide a capital focussing screen is formed.

Without dipping deeply into the somewhat complex optical question of objectives, it is perhaps well to mention here several matters which influence very essentially the focussing of an object for photographing, having regard to the correction of the ordinary microscope objective. In order that "chromatism" (that is, a coloured fringe round the object under examination) may be avoided, certain corrections are made in the objective supplied for ordinary microscopic research, and as a result the lenses composing it have two foci, known respectively as the chemical—*i.e.*, the point at which the blue rays are brought to a focus—and the visual focus, or the point at which the image of the object under examination appears sharpest, but at which very few of the actinic rays of the light are concentrated.

It therefore becomes necessary to determine the exact position of the chemical focus, since to the action of these rays is due the record we subsequently obtain on the sensitised plate. A ready method of roughly arriving at this was suggested to the writer. By placing the focussing screen at a skew of say $\frac{3}{32}$ inches on either side of the centre line of the camera, and focussing sharp for the middle of the screen, we shall have in the centre the true visual focus, and on either side an inclined plane, one in front of, and the other behind the visual focus. At some point within these planes the chemical focus of the objective will be found, some part of the plate being more sharply defined than the rest. The position of this zone from the centre should be noted, and the distance in advance of or behind the visual focus determined. Working, however, with such objectives is tedious and uncertain; and since at a small cost a correcting lens can be added to the objective, the writer strongly advocates this addition. Only the low powers. 3 in., 2 in., $1\frac{1}{2}$ in., and 1 in., require correction, and the additional lens does not impair the value of the objective when required for ordinary microscopic research. In the higher powers, $\frac{1}{2}$ in., $\frac{1}{4}$ in., $\frac{1}{8}$ in., etc., the visual and chemical foci are practically identical, and any actual difference is best disregarded, since the addition of a correcting lens would greatly reduce the amount of light admitted through the objective.

Suppose now the lamp to be ready, and that some object suitable for a trial is to be photographed.

Using the microscope in the ordinary position, the slip on which the object is mounted should be placed on the stage of the microscope and firmly secured by the clips, and an objective with, say, a 1 or 2 in. focal equivalent brought to bear upon it. The object should be brought exactly into the centre of the field, and should be well within its limits. Now place the microscope in its position on the base-board, and carefully bring it to the horizontal position, withdraw the eye-piece, and move the mirror reflector to one side, so that it does not interfere with the light from the lamp, and attach the velvet to the tube.

A very indistinct image of the object will now be seen upon the focussing screen of the camera, but before sharpening the image the illumination must be so adjusted that the whole of the field on the ground glass is evenly illuminated. This can, after a little practice, be readily accomplished by moving the lamp nearer to or farther away from the microscope; but it is well here to remark that uniform illumination can be more readily determined when a medium-sized stop is used in front of the stage than with a larger aperture. The field being satisfactorily illuminated, now sharpen the image on the screen by means of the coarse adjustment of the microscope. Should the image bear further amplification, and yet fall within the limits of the plate used, this should be effected by further extending the camera, though the writer strongly advises the use of $4\frac{1}{4} \times 3\frac{3}{4}$ plates only, and that the whole of the image falls within a circle $2\frac{3}{4}$ in. diameter, or a square $2\frac{3}{4}$ in. by $2\frac{3}{4}$ in., these being convenient sizes for subsequently printing off lantern transparencies from the negatives.

It is best to remove the eye-piece of the microscope, since it makes but a very unsatisfactory amplifier, and generally introduces distortion of the image, whilst it materially reduces the volume of light impinging on the screen.

Sufficient amplification can generally be obtained by extending the camera, but should the range be found insufficient, the distance between the micro-objective and the focussing screen can be readily increased by first removing the vertical sliding front, behind which in most cameras a sufficiently large aperture exists, and stretching out the velvet cone, or funnel, by which the junction between the microscope and camera is effected, as before described. The desired amplification being obtained, focus the image by means of the coarse and fine adjustments. When focussing for taking a photograph care must be taken that the frame in which the focussing screen is held lies in a plane at right angles in all directions to the optical axis.

(To be continued.)

Action of Ether upon Vegetable Life.—According to G. Bernstein, an atmosphere saturated with ether kills the sprouts of wheat and barley in about half-an-hour.

Natural History.

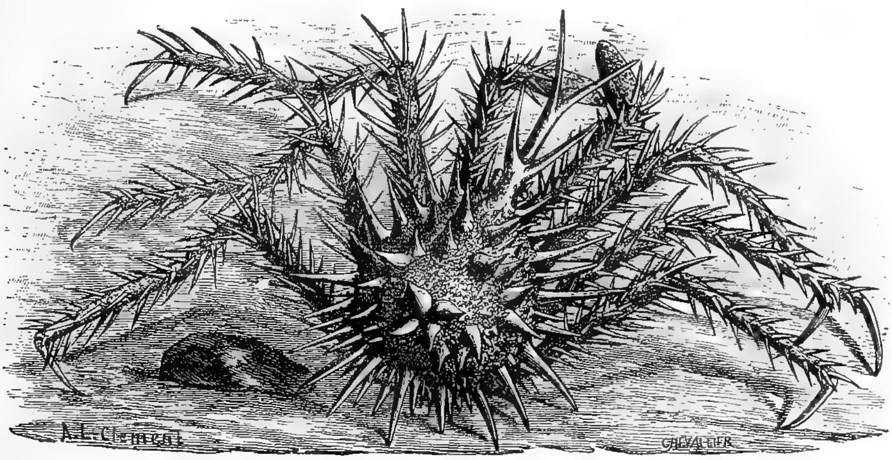
THE CRUSTACEA OF THE SEA-BOTTOM.

M. Fourques gives in *Cosmos* an account of a very strange crab dredged up during the expedition of the *Talisman*, from a depth exceeding 2,000 fathoms. The bottom of the sea was for a long time regarded as uninhabited. The operations required in the Mediterranean in 1881 for re-uniting a broken telegraph cable, immersed at the depth of 1,000 fathoms, revealed to the learned world, to its surprise, that at such depths there existed living beings, in a darkness incompatible with vegetable life, and at a pressure which seemed opposed to all the working of the processes of the animal world. Scientific expeditions were organised, and *savants* set out on vessels whose names have become historical. The *Challenger*, the *Talisman*, and the *Travailleur* carried out soundings at various depths, and a totally novel fauna was described and studied. Several remarkable fishes have been described which live at depths a thousand fathoms below the surface. These fishes do not differ in an essential manner from those of the pelagic fauna. The same species, or closely allied species, are met with at different depths. Their organs, however, present certain modifications imposed by the biological conditions of so peculiar a medium.

The light does not penetrate to such great depths, but nature, in compensation, endows many abysmal animals with luminous organs. Their tissues are, in certain cases and under certain conditions, phosphorescent, like certain *Medusæ* and various terrestrial animals. Our attention for the present must be turned to the *Crustacea*. These creatures—the crabs, lobsters, and their allies—are arthropods, breathing by gills. Devoid of an internal skeleton and of a cerebro-spinal system, they are in this twofold respect similar to insects. Filhol, speaking of marine crustacea—for there are also forms inhabiting fresh water—calls them the insects of the sea, an unfortunate term, since true insects are not entirely wanting in the sea. Their structure and their embryology have been latterly ascertained, and they have been found to undergo numerous and complex metamorphoses. The larval forms were long considered as forming not merely distinct genera but even families. Such are the Zoeæ, the larvæ of the crabs, and Phyllosoma, the larvæ of the shrimps.

These animals are encased in a thick calcareous shell, often armed with long, sharp spines. Their senses are highly developed. At the anterior part of the body they are provided with two pairs of antennæ, the organs of hearing and smelling.

In some species, however, the organs of hearing are lodged at the posterior extremity of the body, under the caudal plate. The organs of touch are very fine and numerous hairs are situated around the mouth. The eyes are sometimes fixed on stalks, and sometimes sessile. There are, indeed, few species subject to so many variations as the crustacea. No fewer than 5,500 living species are known, divided into ten orders, some of which live as parasites upon fishes and are deprived of eyes, and resemble worms in their appearance. Several inhabit the bottom of the sea. During the expedition of the *Talisman*, M. Filhol, one of the naturalists who took part in the expedition, captured a new species and gave it the name of *Lithodes ferox*. It is a very striking animal, of a light-red colour, bristling with spines. It looks like a chestnut which had fallen into the sea, become alive, and shot out arms and legs.



Lithodes Ferox: a Crustacean found at a Depth of 13,000 feet.

Its powerful and terrible armour has earned it the name of *ferox*, for it is impossible to seize it without being wounded, and it must be a very dangerous visitor to its neighbours, so much the more as the crustacea are very voracious and have the power of reproducing any limbs which have been cut or torn away.

Rymer Jones, as quoted by Filhol, gives a very curious anecdote. He had one day placed some crabs in an aquarium, when one of them seized one of its companions by the edge of the shell with one of its pincers, broke open the shell with the other pincer, and fell quietly to work to ransack the body, tearing out pieces of flesh and swallowing them! During this fratricidal feast another crab approached from behind, seized the devourer and holding him firmly, treated him in the same manner. Still he took no notice, but quietly continued his repast until his own death.

The habits of *Lithodes ferox* are little known, but, judging from its structure, it must be a dangerous animal.

A Gigantic Spider.—A correspondent writes to the *Calcutta Englishman*:—I have much pleasure in sending you a description of an enormous spider which was killed in a house here the day before yesterday, and I shall be glad if any reader will inform me whether the species be well known anywhere, or whether there be another Indian species at all corresponding with it in size. I take my description from the specimen in spirits, and can only indulge in regret that I did not see it alive. The creature was found clinging to a door-curtain, and when alarmed emitted a grating sound, but whether with its mandibles or with its feet could not be ascertained. It showed no disposition to run away or even to move from the spot where it was till it was thrown down, when it was killed with a blow of a stick. It is quite two inches in length and half an inch in breadth, and the two segments of the body are equal in size. It is distinctly short legged for a spider; but the eight legs are very strong and heavy. The body, too, is covered with fine short hair and is all of a dark-brown colour. The two fangs are like a sparrow's claws and exceedingly sharp, and if stretched out straight would, with the fleshy part, measure nearly half an inch each. I find it difficult to convey an adequate impression of the terrible and formidable appearance of the monster. The common large running spider, to be found in every house in Calcutta, unhesitatingly tackles and destroys the largest cockroach. Judged by that standard, this spider ought to make its prey of a small bird or a mouse, according to the tales that are told of the South American tarantula.

Sparrow Hawk and Water Hens.—In the *Newcastle Chronicle* a correspondent of Mr. Kerr describes a strange attack of a sparrow hawk on a brood of young water hens which he witnessed. He was trout fishing in the pool in question, a preserved piece of water, which is surrounded with trees, and well fringed with reeds amongst which nest several pairs of water hens and coots. The coots are most pugnacious and jealous birds, and they insist on maintaining possession of the upper part of the pool, driving the water hens to the lower end. As the weather was warm and the situation rathered sheltered, Mr. Kerr's friend got drowsy. At the time, several broods of water hens were sailing about on the pool. Suddenly he was aroused by a squatter and quacking, and on looking up he saw a sparrow hawk grappling with one of the young water hens, about the size of a dabchick. The hawk, when it dashed on its prey, had too much "way," and it nearly went overhead after his quarry. The old water hens at once came to the rescue of their chick, and the sparrow hawk went overhead several times. While the struggle was still doubtful, the hawk being heavily handicapped by having its plumage saturated, the coots sailed in, and made short work of the pirate, whom they pecked and forced under water till he gave up the ghost. The coots and water hens continued to peck the hawk and lash it with their wings long after it was drowned.

Walking Home.—A correspondent of the *Licensed Victuallers' Mirror* tells a marvellous story illustrative of the instinct of the Carrier pigeon, which he vouches for the truth of. A Birmingham man purchased from a well-known fancier in London a pair of carriers (Homers) of purest breed. He was warned that they would certainly fly back home if released. He kept them housed for ten days and gave them their liberty. They, of course, started for home at once. They were returned. The same treatment was repeated twice again with like results. Then he clipped the wings of those pigeons close. The next morning they were missing again. He advertised for them, but could get no clue to their whereabouts. Nearly a fortnight later he received a telegram from Coventry stating that two pigeons, both clipped, answering to the description given in the advertisement, had been captured a few miles from that town. When taken they were walking along the road to London.

Do Snakes Fascinate their Victims?—In a paper published in the last Journal of the Natural History of Trenton, New Jersey, Mr. F. Lucas discusses the alleged power of snakes to fascinate their victims and hold them spellbound by some natural inherent quality. He denies altogether the existence of this faculty, and attributes the general belief in it to the abhorrence, not of mankind only but of most of the lower animals, for snakes. The most absurd stories of this fascination are accepted and cherished as evidences of the potency of the snake's power over man and beast, but, when these are capable of examination and analysis, it usually turns out that, where they are not wholly imaginary, the victim was paralysed with fear rather than rendered powerless by mesmeric influence. It is to the intense nervous perturbation produced in strong men, as well as delicate, sensitive women, by contact with even the smallest of snakes, that Mr. Lucas looks for the secret of the prevalent error regarding the snake's influence. "Man and the lower creatures entertain such fear of the despised ophidian that when unexpectedly meeting one of these horrid animals they are in the proper condition to be peculiarly affected by the fascinating gracefulness and the general appearance of satanic cruelty so natural to the snake. The degree of stupefying influence thus exerted by the snake depends largely on the nervous sensitiveness or the natural timidity of the subject." There certainly are cases where animals have been so terror-stricken by snakes as to be helpless, and where even human beings have been so overcome as to require assistance, but in all such instances the explanation lies in the excessive fear or horror of the victim, and not in an inherent power of the snake to fascinate. Mr. Lucas concludes "that it must be accepted as a scientific verity that the power to fascinate so universally granted to the snake does not exist, but rather, in accordance with the Heaven-pronounced curse on the snake, animated nature in its highest and most sensitive form entertains such strong feelings of fear and repulsion towards this animal, as to suffer temporary paralysis when meeting it."

Animal Chlorophyll.—According to a contemporary, Mr. C. A. McMunn has detected chlorophyll in no fewer then ten species of British sponges, and other observers have detected the absorption-band of chlorophyll in the spectrum yielded by four other species.

The Return of the Sardines.—These little fishes, which had for some time forsaken the coasts of France, have returned in unprecedented numbers. The works of Audierne and its neighbourhood refuse to buy in further supplies at any price. To get rid of what they have already caught, the fishermen are obliged to sell them as manure at half-a-crown per cubic yard!

WATER EGGS OF INSECTS.

WE doubt if there be any equally common object so full of instruction to the young biologist as a string of the eggs of Chironomus. The flies which bear this name are often called midges. They might be summarily described as stingless gnats, which hover in clouds over water in still and warm weather. Their earlier stages are passed in water, but the fly breathes air.

At the time of egg-laying the female Chironomus approaches the water, and lays in it a chain of glutinous eggs. The viscid secretion immediately absorbs water, and swells to many times its original bulk. It then appears as a flexible, transparent cylinder, about three-quarters of an inch long, and perhaps one-tenth of an inch thick. Near the surface of the cylinder are embedded hundreds of yellow eggs, just visible to the eye as oval specks in a clear field. The cylinder ends in a sticky thread, by which the whole mass is moored to a stone or some similar object.

The naturalist who has a fountain in his garden may expect to find these chains of eggs almost constantly during the summer months. In brooks and ponds the eggs are no doubt equally common, but much harder to find.

For the study of the development of insects, no subject can be more advantageous. The eggs are almost perfectly transparent, and may be examined alive with the greatest ease, being afterwards returned to the water to continue their growth. A low power of the microscope, a live-box, and a little saucer of water are the only appliances requisite. The development occupies three days, and the eggs should be examined, whenever possible, at intervals of three hours. To study with profit, drawings to scale should be made with care and regularity.

In newly-laid eggs nearly the whole space is occupied by a granular yolk with many oil globules. At one end, afterwards the hinder end, the peculiar objects known as the polar cells may be seen. Early on the first day of hatching, a single layer of transparent cells is seen to invest the yolk, and within this a second layer rapidly forms. From the outer layer (epiblast) are developed the skin, nervous system, and sense-organs, while the inner layer (hypoblast) gives rise to the epithelium of the primitive alimentary canal.

Towards the end of the first day the yolk has altered its shape. A narrow extension runs out into the region of the future head. Another tongue-like process passes towards the transparent egg-shell, and opens upon the back of the insect, which is as yet in a most incomplete state. The top and side-views of the embryo are now for the first time materially different from each other. Two or three segments are indicated on the ventral surface. By the middle of the second day a considerable number of segments (body-rings) have formed. The dorsal wall is still incomplete. Paired appendages, the future antennæ, mandibles and maxillæ, are now to be made out in the region of the head. The polar cells, which have a singular history, have been taken into the body, but can still be made out. They ultimately undergo conversion into reproductive organs. By the morning of the third day all the segments are formed. The eye-spots are conspicuous. A folding-in of the skin from the head end has produced a long and narrow channel which leads nearly to the yolk. A similar folding-in at the opposite end of the body is in progress. The two new lengths of alimentary canal thus formed constitute the future œsophagus and intestine with their appendages. Uneasy movements are now to be seen, and a sort of peristaltic action of the intestine sets in during the early part of the third day. The body is by this time outwardly completed, and the organisation of the internal organs proceeds with great rapidity, every hour producing visible changes. At the end of about seventy-two hours the egg-shell contains a transparent little larva, which performs restless movements, and soon escapes from its prison. After a few days the larva acquires the red colour which has suggested the popular name of "blood-worm." Its subsequent history is deeply interesting, but we shall not pursue it at present.

Many other small flies lay eggs in water after the same fashion. The string of eggs of the caddis-fly is much larger than that of Chironomus, and the eggs are at first of a brilliant chlorophyll green colour. A curious analogy exists between the insect-eggs just described and the spawn of the frog or toad. In both of these very dissimilar groups of animals the some artifice is used. The oviduct secretes a gelatinous substance, which is poured out upon the eggs, binding them together into a sort of rope, which is small enough while still in the body of the parent, but swells greatly when passed into the water. The copious mass in which the eggs thus come to be imbedded serves more than one purpose. It is slippery, and cannot be seized by beak or claws—whether of bird or rapacious insect. Secondly, it is transparent, and thus serves to space the eggs widely, allowing light to pass freely to each. The influence of light upon the rate of development is very marked. Take any of the eggs named (Frog, Caddis, or Chironomus), divide into two parcels, place both in similar vessels, with the same supply of air and warmth, but keep one set in the dark and the other in the light. The eggs kept in the dark will be found to get on slowly, and a considerable proportion will not be hatched at all. Thus we see that the peculiar requirements of development under water have been independently met in precisely the same way by animals too remote zoologically to admit the supposition of a common tradition.

THE DISTRIBUTION OF COLOURS IN ANIMALS.

SIGNOR L. CAMERANO, after a prolonged study of this question, has laid before the Turin Academy of Sciences certain results which have scarcely received the amount of notice which they merit, and we accordingly submit them to our readers.

He arranges the colours of animals in the following order as regards frequency of occurrence:—1, brown; 2, black; 3, yellow, grey and white; 4, red; 5, green; 6, blue; and 7, violet.

These colours, however, are not uniformly distributed in the main groups of the animal world. Black, brown, and grey are relatively more abundant among vertebrate animals than among the arthropods. Red and yellow, on the contrary, are more frequent among the non-vertebrated animals. Green is common among the lower forms, with the exception of the molluscs, but it is also fairly abundant among the vertebrata, always excepting the mammalia. Violet and blue, the former especially, are the rarest colours. White is very irregularly distributed, but it is most common among dwellers in the waters.

The colours of animals are, on the whole, directly related to the medium which they inhabit. Parasitic animals have less decided and less manifold colours than those which lead an independent existence.

Aquatic animals have in general more uniform and less intense colours than terrestrial forms. Pelagic species have rare and strikingly deep colours—a fact perhaps connected with the frequent transparency of their bodies.

Sea-animals which live among algæ and generally in situations rich in marine vegetation, have a more varied and lively range of colouration than such as live among stones or on a sandy or muddy bottom.

The dull, sombre colour of fresh-water insects is too well known to need more than a passing notice. Some species, however, which pass their larval state in water, *e.g.*, dragon-flies, display a brilliant colouration when mature.

Land animals which live in the woods, beneath herbs, on bushes or on flowers, etc., have more varied and striking colours than the inmates of sandy or rocky localities. The "Desert colour" of the Arabian and Saharan fauna, the former more especially, has been particularly dwelt on by Canon Tristram.

Contrary to the somewhat premature assertion of Mr. Grant Allen, there is no universal and constant connection between the colouration of animals and the nature of their diet. Insectivorous, or rather zoophagous animals which live under leaves or among flowers, are often brilliant and varied in hue, whilst plant-eating species, if they do not regularly inhabit leaves and blossoms, are often dull and sombre in colour.

Still this generalisation is as far as that of Mr. Grant Allen from accounting for the gorgeous colouration of, *e.g.*, the genus *Phanæus*, devourers of carrion and excrement among which they make their abode.

The richer an animal group is in species the more varied, and in many cases the brighter is their colouring —a rule well exemplified in the humming-birds. But it fails us in not a few striking cases, among which we need merely mention the great group of the *Brachelytra* or rove-beetles, the *Harpalidæ*, and the genus *Aphodius*.

The development of colour bears no direct proportion to the quantity of light to which the animal is exposed. It is rather directly connected with the general development of the animal. Deficient nutrition and diseases impoverish the colours.

Large animals have, for the most part, a duller colour than smaller species. We need scarcely add that the views of Signor Camerano as regards the influence of light agree substantially with those of Mr. A. R. Wallace.

A very dry climate seems to darken colours, whilst a very moist one brightens or lightens them. The colours of animals are modified by the altitude of their station above the sea-level. The higher we rise, thinks Signor Camerano, the more intense are the colours which encounter our view.

With this proposition we cannot agree. A mountain fauna is generally more sombre than that of the adjacent plains—a remarkable contrast to the Alpine flora. This fact, indeed, has been cited as an argument against Mr. Grant Allen's theory of the colouration of animals.

Species confined to islands have often darker colours than those inhabiting continents. This conclusion holds strikingly good as regards many varieties inhabiting small islands.

It will be seen that the colouration of any given fauna is a result depending on a complex of factors, the respective influence of which it is hard to estimate.

The different zoo-geographical regions of the earth seem to have certain more or less predominating colours.

In the Palæarctic region, white, grey, black, and yellowish are frequent; in the Ethiopean, yellow and brown; in the Neotropical, green and red predominate (?); in the Indian the yellow tones occur very plentifully; whilst in the Australian dark colours, and especially black, take the lead.

In almost all groups of animals those parts which are less visible are often brightly coloured or spotted, whilst the other parts of the body are more frequently unicoloured, or dark. Here, however, we are reminded of the very numerous cases in insects where the brightest colours appear to be seated in projecting parts, such as the extremity of the abdomen, the tips of the elytra in *Coleoptera* and *Hemiptera*, the margins of the wings in butterflies, etc. So frequent is this phenomenon that some naturalists have regarded it as a protective arrangement—a bird, *e.g.*, being more likely to strike at these bright, outlying parts than at the more sombre vital regions.

In many cases the young of different species resemble each other closely in colouration, though the adults are quite distinct.

While thus giving an abstract of the very interesting results of Signor Lorenzo Camerano, we are fully aware that some of them require further consideration. It must have struck many of our readers that inquiries on the colouration of animals have, so far, left the physical side of the question scarcely touched. The production of the colouring-matters, their occurrence in one species and not in another, and the mechanism of their distribution have still to be dealt with. It strikes us that in the production of the design—in *e.g.*, the wings of a butterfly—the principles of capillary attraction and of diffusion must come into play. By mixing certain colours which have different rates of diffusion and placing a small drop of the mixture on white blotting-paper, designs may sometimes be obtained which roughly resemble those we meet with in the wings of Lepidoptera.

THE ELECTRICAL TRANSMISSION OF POWER.

A Lecture Delivered by Professor Ayrton, F.R.S., etc., before the British Association, on September 8th, and Re-delivered to the Working-Classes of Bath, on September 13th, 1888.

(*Continued from p. 321.*)

Let us study this electric transmission a little in detail. I pull this handle, and the bell at the other end of the room rings, but in this case there is no visible motion of anything between the handle and the bell. (Electric bell rung by an electric current produced by pulling the handle of a small magnetic-electric machine.) Whether I ring the bell by pulling a wire, or by sending an air puff, or by generating an electric current by the exertion of my hand, the work necessary for ringing the bell is done by my hand exactly as if I took up a hand bell and rang it. In each of the three cases I put in the power at one end of the arrangement, and it produces its effect at the other. In the electric transmission how does this power travel? Well, we do not know: it may go through the wires, or through the space outside them. But although we are really quite in the dark as to the mechanism by means of which the electric power is transmitted, one thing we do know from experience, and that is this—given any arrangement of familiar electrical combinations, then we can foretell the result.

Our knowledge of electrical action in this respect resembles our knowledge of gravitation action. The only thing quite certain about the reason why a body falls to the ground is that we do not know it; and yet astronomical phenomena can be predicted with marvellous accuracy. I mention the analogy since some people fancy because the answer to that oft-repeated question "What is electricity?" not only cannot be given exactly, but can only be guessed at in the haziest way, even by the most able that therefore all electric action is hap-hazard. As well might the determination of a ship's latitude at sea be regarded as a mere game of chance because we have not even a mental picture of the ropes that pull the earth and sun together.

This power of producing an action at a distance of many yards, or it may be many miles, by the aid of electricity without the visible motion of any substance in the intervening space is by no means new. It is the essence of the electric telegraph, and electric transmission of power was employed by Gauss and Weber when they sent the first electric message. I am transmitting power electrically whether I now work this small model needle telegraph instrument, or whether I turn this handle and set in motion that little electric fan.

But until about ten years ago the facility that electricity gave for producing signals almost instantaneously at a great distance was the main thing thought of. The electric power consumed for sending the telegraph messages was so small, the amount of power lost *en route* comparatively so valueless, that the telegraph engineer had no need to trouble himself with these considerations that govern us to-day, when we are transmitting power large enough to work a factory or an electric tramway. Although there are as many as 22,560 galvanic cells at the Central Telegraph Office, London, which costs some thousands annually to keep in order, what is that compared with the salaries of all the 3,089 superintendents, assistants, telegraph clerks, and the maintenance of 1,150 telegraph lines that start from the Central Office?

In all the last three systems on my list some form of power such as flowing water or the potential energy stored up in coal, wood, zinc, or other fuel, has initially to be utilised. This power is given to some form of air, water, or electric pump which transfers the power to the air, water, or electricity by which it is conveyed to the other end of the system. There it is re-converted into useful mechanical power by means of an air, water, or electric motor.

You will observe that I class together air, water, and electricity; by that I do not mean to imply that electricity is a fluid, although in many respects it acts like a fluid, like a fluid of very little mass, however, or, odd as it may seem, like a fluid moving extremely slowly, for electricity goes round sharp corners with perfect ease and without any of the phenomena of momentum possessed by rushing water. But what I particularly wish to impress on you by classing air, water, and electricity together is that electricity is not, as some people seem to think, a something that can be burnt, or in some way used up and so work got out of it. Electricity is no more a source of power than a bell wire is; electricity is a marvellously convenient agent for conveying a push or a pull to a great distance but is not by the using up of the electricity that electric lights burn or that electro motors revolve. It is by the electricity losing pressure, exactly as water loses head when turning the miller's wheel as it flows downhill, that work is done electrically.

This model shows in a rough symbolical way what takes place in the transmission of power, whether by air, water, or electricity. The working stuff, whichever of the three it may be, is first raised in pressure and endowed with energy, symbolised by this ball being raised up in the model; it then gradually loses pressure as it proceeds along the tube or wire which conveys it to the other end of the system, the loss of pressure being accompanied by its giving up power to the tube or wire and heating it. This is shown in the model by the ball gradually falling in its course. At the other end there is a great drop of pressure corresponding with a great transference of power from the working stuff to the motor, and finally it comes back along the return pipe or wire, losing, as it returns, all that remains of the pressure given to it initially by the pump. The ball has, in fact, come back to its original level.

The problem of economically transmitting power by air, water, or electricity is the problem of causing one or other of these working stuffs, air, water, or electricity, to economically perform the cycle I have described.

In each of the four stages of the process—

(1) Transference of power to the working substance at the pump,

(2) Conveyance of power to the distant place,

(3) Transference of power from the working substance to the motor at the distant place,

(4) Bringing back the working substance—

there is a loss of power, and the efficiency of the arrangement depends on the amount of these four losses. The losses may be shortly called—

(1) Loss at the pump,

(2 and 4) Loss on the road,

(3) Loss at the motor.

Until 1870 the pump most generally employed for pumping up electricity and giving it pressure, was the galvanic battery, scientifically an extremely efficient converter of the energy in fuel into electric energy, only unfortunately the only fuel a battery will burn is so expensive. A very perfect fireplace in which there was very complete combustion, and a very little loss of heat, but which had the misfortune that it would only burn the very best wax candles would be analogous with a battery. The impossibility of using zinc as fuel to commercially work electric motors has been known for the last half-century, and the matter was very clearly put in an extremely interesting paper "On Electric Magnetism as a Motive Power," read in 1857, by Mr. Hunt, before the Institution of Civil Engineers, a copy of which has been kindly lent me by Dr. Silvanus Thompson. Professor William Thompson, of Glasgow, I quote from the discussion on the paper, put the matter very pithily by showing that even if it were possible to construct a theoretically perfect electromotor, the best that could be hoped for if it worked with a Daniell's battery would be the production of a one-horse power by the combustion of 2 lbs. of zinc per hour, whereas with a good actual steam engine of even thirty years ago, one horse power could be produced by the combustion of exactly the same weight of the much cheaper fuel, coal. This argument against the commercial employment of zinc to produce electric currents is irresistible unless—and this is a very important consideration which is only beginning to receive the attention it deserves—unless, I say, the compound of zinc formed by the action of the battery can be reduced again to metallic zinc by a comparatively inexpensive process, and the zinc used over and over again in the battery. If the compound of zinc obtained from the battery be regarded as a waste product then it would be much too expensive to work even theoretically perfect electromotors if they were existent by consuming zinc. Suppose, however, a process be devised by means of which burnt zinc can be unburnt with an expenditure comparable with the burning of the same weight of coal, then it might be that although coal would still form the basis of our supply of energy the consumption of zinc in batteries might be an important intermediary in transforming the energy of coal economically into mechanical energy.

While then some experimenters are aiming at possibly increasing the working power of a ton of coal to eight times its present value by earnestly seeking for a method of converting the energy it contains directly into electric energy without the intervention of a wasteful heat engine, it should not be forgotten that in the cheap unburning of oxidised metal may lie another solution.

The solution of this latter problem is quite consistent with the principles of the conservation and dissipation of energy since the heat required to theoretically unburn 1 lb. of zinc is only one-seventh of that given out by the burning of 1 lb. of coal. Further, it involves no commercial absurdity like that found in the calculations given in the prospectuses of many primary battery companies which are based on zinc oxide, a material used in the manufacture of paint, maintaining its present price, even if thousands of tons were produced. Unless all those who use primary batteries on this expectation intend to have the painters doing up their houses all the year round, they will find themselves possessed of the stock-in-trade of an oil and colourman on a scale only justified by a roaring business in paint.

Now about waste No. 3—the waste of power at the motor. That also was gone into fully in the discussion in Mr. Hunt's paper, and Mr. Robert Stevenson concluded that discussion by remarking "That there could be no doubt from what had been said, that the application of voltaic electricity, in whatever shape it might be developed, was entirely out of the question, commercially speaking. . . . The power exhibited by electro-magnets extended through so small a space as to be practically useless. A powerful electro-magnet might be compared, for the sake of illustration, to a steam engine with an enormous piston but with an exceedingly short stroke. Such an arrangement was well known to be very undesirable."

And this objection made with perfect justice against the electro-motors of thirty years ago, might also have been made to all the machines then existing for the mechanical production of electric currents. I have two coils of wire at the two sides of the platform joined together with two wires. I move this magnet backwards and forwards in front of this coil, and you observe the magnet suspended near the coils begins to swing in time with my hand. Here you have, in its most rudimentary form, the conversion of mechanical power into electro power, and the re-conversion of electric power into mechanical power; but the apparatus at both ends has the defects pointed out by Mr. Hunt and all the speakers in the discussion on his paper—the effect diminishes very rapidly as the distance separating the coil from the moving magnet increases.

As long as electro-motors as well as the machines for the production of electric currents had this defect, the electric transmission of power was like carrying coals to Newcastle in a leaky wagon. You would pay at least sixteen shillings for your coals in Bath, lose most of them on the way, and sell any small portion that had not tumbled out of the wagon for say two shillings a ton at Newcastle—a commercial speculation not to be recommended.

A very great improvement in electro-motors was made by Pacinotti in 1860, but although his new form of electro-motor was described in 1864 it attracted but little attention, probably because any form of electro-motor, no matter how perfect, was commercially almost useless until some much more economical method of producing electric currents had been devised than the consumption of zinc and acids. Pacinotti's invention removed from motors that great defect that had been so fully emphasized by the various speakers at the reading of Mr. Hunt's paper in 1857. When describing his motor in the Nuovo Cimento in 1864 he pointed out that his principle was reversible, and that it might be used in a mechanical current generator. This idea was utilised by Gramme in 1870, who constructed the well-known Gramme dynamo for converting mechanical into electrical power, a machine far more efficient that even Pacinotti had contemplated, and gave the whole subject of electrical engineering a vigorous forward impulse. Every subsequent maker of direct-current dynamo, or motors, has followed Gramme's example in utilising the principle devised by Pacinotti, which was as follows :—In all the early forms of dynamos or motors there were a number of magnets and a number of coils of wire, the magnets moving relatively to the coils, or the coils relatively to the magnets, as you see in this rather old specimen of alternate current dynamo. To produce magnetism by a large number of little magnets is not economical, and Pacinotti's device consisted in arranging a number of coils round a ring in the way shown in the large wooden model, so that they could all be acted on by one large magnet. Instead of frittering away his magnetism, Pacinotti showed how it could be concentrated, and thus he led the way to dynamos and motors becoming commercial machines. Pacinotti's science engineered by Gramme not only made electric lighting commercially possible, but led to electricity being used as a valuable motive power. It was in their work that the electrical transmission of power in its modern sense sprang into existence.

Quite recently an improvement in the same direction has been introduced into alternate current dynamos by Mr. W. N. Mordey, for he has replaced the many magnets of the ordinary alternate current dynamos with one large magnet, and so with his alternator, weighing 41 cwt., which you see in this hall, he has succeeded in obtaining at a speed of 650 revolutions per minute an output of 53·6 horse-power with a high efficiency.

It may be convenient to mention at this stage the very valuable work done by the Doctors Hopkinson, Crompton, Kapp, and others in the improving dynamos and motors by applying scientific principles in the construction of these machines. Were I lecturing on dynamos and motors instead of on the electric transmission of power, I would explain to you how by putting more iron into the rotating armature, as it is called, and less wire on it, by shortening the stationary magnet, and generally by concentrating the magnetic action, these constructors have raised the commercial efficiency of these machines to actually as high as between 93 and 94 per cent.; further, how by recognising the force of the general principles laid down by Professor Perry and myself as to the difference that should exist in the contruction of a motor and a dynamo Messrs. Immisch have succeeded in constructing strong durable electro-motors weighing not more than 62 lbs. per effective horse-power developed.

The subject is so entrancing to me, the results commercially so important, that I am strongly tempted to branch off, but the inexorable clock warns me that I must concentrate my remarks as they have concentrated the magnetic action.

Of the power put into an Edison Hopkinson dynamo 87½ per cent. has actually been given out by the motor spindle, when 50-horse power was being transmitted. How does this compare with *combined* efficiencies of an air pump and an air motor, or of a water pump and a water motor? I understand that in either of these cases 60 per cent. is considered a very satisfactory result. As far, then, as the terminal losses are concerned, electric transmission of power is certainly superior to air or water transmission.

The next point to consider is the loss of power on the road between the dynamo at the one end and the motor at the other. This problem was perhaps seriously attacked for the first time in the discussion of a paper read by Messrs. Biggs and Brittle at the Institution of Civil Engineers in 1878, and that problem was considered in some detail, theoretically and experimentally, at the lecture I gave during the meeting of the British Association in Sheffield in the following year. It was then shown that, since the power developed by the generator and motor depended on the product of the current into the electric pressure, while the loss when power was transmitted through a given wire depended on the square of the current and was independent of the electric pressure, the economical transmission of power by electricity on a large scale depended on the use of a very large electric pressure and a small current, just as the economic transmission of much power by water depended on the use of a very large water pressure and a small flow of water. At that time it was not thought possible to construct a small dynamo to develop a very large electric pressure, or potential difference, as it is technically called, and therefore it was proposed to join up many dynamos in series at the one end, and many lamps or electric motors in series at the other, and to transmit the power by a very small current which passed through all the dynamos and all the lamps in succession one after the other.

You have an example to-night of the realisation of this principle in the fifteen arc lamps that are all in series outside this Drill Hall, and are worked with a small current of only 6·8 ampères, as indicated in the wall diagram; and a further example in the thirty arc lamps at the Bath Flower Show, which are also all worked in series with the same small current passing through them; but it is known now how to produce a large potential difference with a single dynamo, so that a single Thomson-Houston dynamo belonging to Messrs. Laing Wharton and Down supplies the current for each of the two circuits.

The electric pressure, or potential difference, between terminals of any arc lamp is not high, but it is between the main wires near the dynamo as well as between these wires and the ground. How far does this lead to the risk of sparks or unpleasant shocks. This is a point that can be looked at in a variety of ways. First there is the American view of the matter, which consists in pointing out to people exactly what the danger is, if there be any, and training them to look out for themselves; let ordinary railway trains, say the Americans, run through the streets, and let horses learn to respect the warning bell. Next there is the semi-paternal English system, which cripples all attempts at mechanical street locomotion, because we are Conservative in our use of horses, and horses are Conservative in their way of looking at horseless tramcars. Lastly, there is the foreign paternal system which, carried to its limit, would prohibit the eating of dinners because some people at some time choked themselves, and would render going to bed a penal offence because it is in bed that most people have died.

We laugh a good deal at the rough and ready manner adopted on the other side of the Atlantic. The Americans, no doubt, are very ignorant of the difficulties that properly-minded people would meet with, but it is a blissful ignorance where it is folly to be wise. Every English electrician who has travelled in America comes back fully impressed with their enterprise and their happy-go-lucky success. They have twenty-two electric tramways, carrying some 4,000,000 passengers annually, to our four electric tramways at Portrush, Blackpool, Brighton, and Bessbrook. Why, New York City alone, Mr. Reckenzann tells me, possesses 300 miles of ordinary tramway track, and Philadelphia city 430 miles, so that there is more tramway line in these two cities than in the whole of the United Kingdom put together. Now there would be no difficulty in proving to anyone unfamiliar with railway travelling that to go at fifty miles an hour round a curve, with only a bit of iron rail between him and eternity, would be far too risky to be even contemplated. And yet we do go in express trains, and even eighty miles an hour is beginning to be considered not to put too great a demand on the funds of life insurance companies. The American plan of basing a conclusion on experience rather than anticipations is not a bad one, and if we follow that plan, then taking into account that there are 75,000 arc lights alight every night on the Thomson-Houston high potential circuits throughout the world, and the comparatively small number of people that have suffered in consequence—not a single person, I am assured, outside the companies' staff, we are compelled to conclude that high potential now is what thirty miles an hour was half a century ago—uncanny rather than dangerous.

But it is possible to use a very large potential difference between the main wires, by means of which the electric power is economically conveyed a considerable distance, and transformed into a small potential difference in the houses where it is utilised. An electric transformer is equivalent to a lever, or wheel and axle, or any other of the so-called mechanical powers. You know that a large weight moving through a small distance can raise a small weight through a large distance; there is no gain in the amount of work, but only a transformation of the way in which the work is done. A large weight moving through a small distance is analogous with a high potential difference and a small current, while a small weight moving through a large distance is analogous with a small potential difference and a large current, and an electric transformer is for the purpose of effecting the transformation with as little loss of power as possible, so that what is lost in potential difference may be all gained in current.

Electrical transformation may be effected by

(1) Alternate current transformers,
(2) Motor-dynamos,
(3) Accumulators, or secondary batteries,
(4) Direct current transformers.

Of these apparatus the oldest by far is the alternate current transformer, as it is merely the development of the classical apparatus invented by Faraday in 1831, and familiar to many of you as the Ruhmkorff or induction coil. A combination of a motor and dynamo was suggested by Gramme in 1874. Accumulators are the outcome of Planté's work, while direct current transformers are quite modern and not yet out of the experimental stage.

After studying the literature on the subject, it appears, as far as I have been able to judge, that the first definite proposal to use a high potential difference in the street mains and transform down to a low potential difference in the houses, was made in the lecture given by me at the meeting of the British Association in Sheffield in 1879, on which occasion I explained and showed in action the motor-dynamo principle suggested by Professor Perry and myself. The apparatus on the platform is not unlike that shown on the former occasion; an Immisch motor working at 500 volts and with a current of 6·8 amperes is geared direct to a Victoria brush dynamo giving five times that current, and we will now use this larger current to produce an electric fire. Messrs. Paris and Scott have combined the motor and dynamo into one machine, which they have kindly lent me, and by means of which we are now transforming about 700 volts and 6·8 amperes into 100 volts and about 40 amperes used to light that group of incandescent lamps and work these motors.

Lastly, here is a working illustration of the double transformation proposed by M. Deprez and Carpentier in 1881, by means of which, while the potential difference between the mains may be two or ten thousand volts if you like, not merely is the potential difference in the house so low that you could hardly feel anything if you touched the wires, but in addition there is the same security against shocks in the dynamo-room. This alternate current machine is producing about 50 volts, which is transformed up to 2,000 volts by means of this transformer. At the other end of the platform, by means of a similar transformer, the 2,000 volts is transformed down again to 50 volts employed to light that cluster of low voltage incandescent lamps.

In this experiment there is, as a matter of fact, still more transformation than that I have yet mentioned, because, whereas in actual practice the alternate current-dynamo, as well as the small dynamo used to produce the current for magnetising the electro-magnets in the alternate current-dynamo, would be worked by a steam, gas, or water engine, I am working them both by electro-motors, since a steam engine or a water wheel would be an unsuitable occupant of the Drill Hall. Practically then, a steam-engine on the land belonging to the Midland Railway Company, on the other side of the lower Bristol road, is driving a Thomson-Houston dynamo; this is sending a small current working these high voltage, constant-current Immisch motors. The motors being geared with low voltage dynamos, the potential difference is transformed down, the first alternate current transformer transforms it up again, and the second alternate current transformer transforms it down, so that there are, in fact, three transformations taking place in this experiment on the platform before you.

(*To be continued.*)

Abstracts of Papers, Lectures, etc.

SOCIETY OF ENGINEERS.

On Tuesday, 25th September, this Society visited the London and South-Western Railway Locomotive Carriage and Waggon Works at Nine Elms.

These famous works, which were originally designed by the late Mr. Joseph Beattie, and at that time considered very complete, have been, owing to the increase of traffic and stock, considerably altered and enlarged by Mr. William Adams, the present superintendent.

The works, which cover 45 acres of ground, are situated at Nine Elms, which is on the south-east side of the main line after leaving Vauxhall station; and between 2,000 and 2,500 men are employed.

The locomotive department consists of machine, erecting, wheel, smiths', fitters, cylinder, brass, coppersmiths, boiler, tender-fitters', mounting and pattern shops, grindery, iron and brass foundries, and running sheds. The "short" machine shop is a large brick building, well lighted, and is 164 ft. long by 57 ft. wide. It is well fitted with the most modern classes of machine tools, milling machines being conspicuous by their large numbers, notably an horizontal milling machine by Messrs. Muir, of Manchester. These machines leave the work in such a state of perfection, that further attempt at finishing with a file would only spoil it. On leaving the "short" machine shop the cylinder shop is entered, which is provided with a very useful overhead travelling crane, made at Nine Elms. Here there are two very fine vertical milling and drilling machines, which are used for machining the valve faces of cylinders. This shop is 57 ft. long by 29 ft. wide. In the fitting shop, which is 118 ft. long by 58 ft. wide are several "vortex blast pipes," the invention of Mr. W. Adams. There is no doubt that when this pipe is designed on thoroughly scientific principles that a great saving of fuel is effected, and this has been proved by the gradual decrease of coal consumption during the last three years on the South Western Railway. We may here mention that the average consumption of fuel in 1885 was 30 lbs. per engine mile, which has now been reduced to 26½ lbs. per mile. This has effected a total saving, since June, 1885, of nearly £34,000. In the brass shop is made the white metal piston and valve rod packing, which is a standard now with all new engines of the South Western Railway, and is giving the greatest satisfaction. The millwrights' shop is 85 ft. long by 58 ft. wide, and is fitted with very modern machinery. The "long" machine shop is 300 ft. long by 57 ft. wide—the standard width of the shops at Nine Elms. A piston-rod grinding machine is here in use. The rods are first roughed down in the lathe and finished off here.

The erecting shops consist of two bays, each 500 ft. long by 57 ft. wide, and which have accommodation for seventy engines. There are three roads in each bay.

Each erecting shop is provided with two 25 tons overhead travelling cranes, which are capable of lifting an engine bodily from one road to another, and each is capable of lifting and travelling transversely and longitudinally at one time, all of which operations are controlled by one man. Hydraulic piping, supplied with water at a pressure of 1,500 lbs. per square inch, is laid throughout the entire length of these two shops, so that small hydraulic tools can be worked from this source of power. The boiler shop, which is 178 ft. long by 116 ft. wide, is divided into two bays, the first of which contains the machine tools. There is also a plate-grinding machine which has been recently made at Nine Elms, and is found to be thoroughly efficient. A very large number of boilers are in progress of manufacture. Steel, with the exception of the firebox and tubes, is wholly used in their manufacture; manganese steel stays are now replacing copper for the firebox. In the adjoining bay is fixed one of Tweddell's stationary hydraulic rivetters, having 11 ft. 6 in. gap. In connection with this is a 7 tons hydraulic crane. In the hydraulic engine house are fixed two pairs of engines by the Hydraulic Engineering Company of Chester, which supply water at a pressure of 1,500 lbs. per square inch to an adjoining accumulator, from which all the hydraulic tools in these shops, including three turntables, are worked. The smiths' shop is 194 ft. long by 57 ft. wide, and contains twenty-six forges, inclusive of bolt makers' fires. The forge and spring makers' shop is a large brick building 176 ft. long by 51 ft. wide. The iron foundry is served by two 5 tons steam cranes by Appleby Bros. Adjoining this is the brass foundry, which is fitted with Fletcher's furnaces and the usual appliances. The carriage building shop is a well-lighted building 194 ft. long by 60 ft. wide, in which the bodies and under-frames of coaches are built. This shop is heated by exhaust steam. In the saw mill all the saw-dust, etc., is automatically conveyed by a fan to a collecting tower, from whence it is utilised to raise steam in one of the stationary boilers. The whole of the shafting for driving the various machines is fixed below the floor, which arrangement keeps all the driving bands out of the way, and does not necessitate the use of counter-shafts.

In the carriage machine shop, which is 194 ft. long and 57 ft. wide, are numerous drilling, nut tapping, shaping, and slotting machines. There is also a brick factory, in which the fire bricks for the brick arches of locomotives and furnaces at Nine Elms are made. The running shed is 235 ft. wide by 180 ft. long, and is capable of holding 60 engines. At the east end of the works, *i.e.*, towards Vauxhall Station, is situated a large shop 225 ft. long by 170 ft. wide, in which are made the road vans and outstation furniture, and attached is a small saw mill and smithy, with the necessary tools for quickly despatching this class of work. Four of the arches under the main line are fitted up as dining halls for the workmen; the remainder being used as shops and stores. The South Western Railway has now in operation about 850 miles of line, which is served by 550 locomotives, 3,000 carriages, and 8,000 waggons.

This completed a very interesting tour of the London and South Western Railway shops; but, perhaps, the chief characteristic that pervades the works is the evidence of vitality and vigour of the Management, which is sufficient to account for the rapid progress made by this establishment under the superintendence of Mr. William Adams during the last few years.

MANCHESTER MICROSCOPICAL SOCIETY.

At the meeting held on September 13th, Mr. James Hart, F.C.S., read a communication on "Insect Powder." After referring to powders previously used as insecticides, he described the insect powder in most common use to-day, which is prepared from the flowers of *Pyrethrum roseum*, or *P. cinerariefolium*, the former known as Persian, and the latter as Dalmatian insect powder. The powder from Dalmatian flowers is acknowledged to be the best and strongest, owing, perhaps, to the fact that fewer double flowers are found in it than the Persian. More than twenty years ago a German traveller described this powder as a sure protection against all kinds of insects, and by making a tincture of the flowers, diluting it with water, and sponging his body he was enabled to sleep without even the protection of the mosquito net. An American naturalist describes the action of the powder on different insects. The smell does not affect them, but, when carried to the maxillæ or mandibles, complete paralysis of the motor nerves takes place, the legs being paralysed in regular order, beginning at the first pair. Different classes of insects are susceptible in varying degrees to its influence, all insects having open mouthparts being peculiarly liable to its influence, whilst others, such as the Hemiptera, owing to their peculiarly-shaped mouths, are able to vigorously resist it. The plant itself is quite inactive and utterly valueless as an insecticide. The best powder is prepared from half-open or closed flowers, that prepared from open flowers being much weaker. After describing the structure of the flowers by means of drawings, Mr. Hart drew the attention of the meeting to an adulterated powder which is being sold in large quantities at a price fifty per cent. below that at which the genuine can be procured. This powder is made by grinding up the entire plant, which, as before stated, is innocuous. It also contains at least twenty-five per cent. of wheat starch and twelve per cent. of yellow ochre, so that the insects who come across this so-called insecticide must have had quite a joyful time of it, for twenty-five per cent. of it they can devour with impunity, and the rest will not have the slightest effect upon them.

An interesting discussion followed the reading of the paper, more especially as to the use of the microscope in detecting adulterations. The general impression seemed to be that for mineral adulterants it was not of much use, chemical analysis in these cases being requisite, but that in the detection of organic adulterants it was a most valuable instrument to the analyst, as is shown by the numerous illustrations of the microscopic appearance of various food-stuffs which are given in the standard works on the subject of analysis of food and drugs. As to the percentage of adulteration which it is possible to detect by a microscopical examination, considerable difference of opinion seemed to prevail. In the case of an adulteration by means of starch it was held by some that five per cent. of the adulterant would escape, whilst others thought that so low a percentage as one per cent ought to be detected by anyone acquainted with the microscopic appearance of the commercial starches. It was agreed by all that if the adulterant were rice starch one per cent. ought to be detected, owing to the peculiar character of the grains of rice starch.

Mr. Edward Ward, F.R.M.S., described some microscopical objects met with in an afternoon's ramble, and showed under the microscope slides prepared from them. He mentioned an instance of what he considered communication on the part of the ants. Wishing to obtain some he found that they climbed a certain plant, from which he could brush them into his collecting bottle, but after a time very few ants came upon the leaves, and those that did so turned back, his impression being that they had been warned by others of the danger attending such a course. He gathered a number of flowers of the mallow (*Althœa officinalis*), the anthers and pollen grains of which make beautiful microscopic objects. He had found that in preparing it from the fully-opened flower, most of the pollen grains fell off, whereas, by gathering the unopened buds, stripping off the leaves, and drying the anthers out of reach of dust, much better results were obtained. He had also noticed that wheat was largely infested by a fungus (*Ustilago segetum*) commonly known as the corn smut. This fungus, however, does not damage the flour, as the fungus reaches maturity, dries, and is scattered by the wind before the corn is ripe. The other fungus which affects wheat, the wheat bunt (*Tilletia caries*) is not so common, but is much more destructive, and is a more insidious foe to the farmer. In the case of this fungus the ears of wheat remain green and externally there is no appearance, except to the practised eye, that anything is wrong. There is no black impalpable dust about the ears as in the "smut," but stealthily and secretly the work is accomplished, and until the bunted grains make their appearance in the sample the disease may, perchance, be unchallenged. When the grain is broken, the farinaceous interior will be found replaced by a minute black dust of a very fetid, unpleasant odour and greasy to the touch. Flour which contains a large proportion of bunt is injurious in proportion to its extent. The prevalence of these fungi on wheat is due to the wet summer we have had, as it is well known that many fungi flourish in proportion to the wetness of the season.

Mr. Parkes read a paper on the nest of a trap-door spider found at Ajaccio in Corsica, and exhibited four nests.

Malton Naturalists' Society.—At the meeting held on September 24th, Mr. Matthew B. Slater, the curator, reported a most interesting discovery during the recent excursion of the union to Houghton Woods, Market Weighton. In a fir forest there a Mr. Marshall had found eight specimens of *Goodyera repens*, which Mr. Slater states has never previously been found in Yorkshire, and only once before in England. The "find," he added, was an interesting one, geologically as well, as the *Goodyera* is an old Arctic plant, found chiefly in the North of Europe, and flourishes in the fir forests of North Britain.

Leicester Working Men's Club and Institute.—Mr. A. Berry delivered the first lecture of the season on September 25th, taking "The Moon" as his subject.

Liverpool Science Club.—On September 22nd a large number of the members of this club met in the Museum, William Brown-street, to hear a lecture by the Rev. F. F. Grensted, M.A., on "Egyptian and Babylonian Antiquities." Beginning with a clean-cut Egyptian tombstone, carved some 3,500 years before the Christian era, the lecturer showed the peculiar religious belief of the Nile dwellers of that age. The growth of language was also pointed out, and the strange developments of totemism as shown by the mummy cats and other strange animal forms preserved in the museum. The pictures of the last judgment, as taken from the book of the dead and figured on one of the mummy cases, attracted much attention, as showing the peculiar notions of the Egyptians with regard to a future state. The tools of the ancient races were compared with the tools of the modern mechanic, and it was shown how nearly allied we are in many respects to the long perished races, and comparisons were made on points of labour, language, literature, and religion.

Sydney Natural History Association.—The fifth excursion of members of the association took place on Saturday, June 30th, the locality selected being on the western slope of Bellevue Hill, and in the adjacent gully. The following plants were found and examined: *Persoonia tenuifolia*, *P. lucida*, *Hakea rostrata*, *H. acicularis*, *H. bifurcata*, and *H. flexilis*, *Banksia serrata*, *B. marginata*, and *B. integrifolia*, *Lambertia formosa*, *Grevillea sericea*, and *Xylomelum pyriforme*, the "wooden pear" of the settlers. Among leguminous plants collected and examined were *Bossiœa ensifolia* and *B. scolopendria*, *Hardenbergia monophylla*, *Hovea linearis*, and four or five species of acacia. It was rather early in the season for the majority of flowering plants; but some of the genera Rutacæ were just commencing to unfold their charms, the species collected being *Correa speciosa* (known to bush children as the native fuchsia), *Crowea saligna*, *Boronia ledifolia*, *B. floribunda*, and *B. parviflora*. The epacrids were also beginning to display their beauty, being represented by the handsome though cosmopolitan *Epacris longiflora*, *E. microphylla*, and *E. pulchella; Styphelia tubiflora*, *S. viridis* (much sought after in the summer season for its fruits, known as five-corners), and *Astroloma hemifusa*. Among ferns collected in the gully were *Todea barbara*, *Davallia dubia*, *Lomaria discolor*, *Gleichenia circinnata*, and *G. rupestris*, *Schizara dichotoma*, and *S. rupestris*. Here also was found, growing in the spongy soil, saturated with the drip of water from the rocks above, that curious plant, *Drosera binata*, one of Darwin's carnivorous plants, with broad, deeply-cleft leaves, the lamina presenting the figure of a V; while the petioles are several inches in length.

Agri-Horticultural Society of Burma.—From the proceedings of the meeting held on August 11th, we learn that during June and July special attention had been paid to moth collecting, as Colonel Swinhoe, who is naming them for the Museum, intended leaving India for Europe at the end of this year. Good specimens of a large number of species had been obtained, of which over one hundred were new to the collection. Two or three of each variety had been sent to Col. Swinhoe for identification, and very many were most likely new to science. In such cases he would take them to Europe with him, and describe them there, and then return the specimens. He has several specimens now with him which he considers new, but for want of sufficient books of reference has not described. He has as yet only returned a small number of those sent to him in the beginning of June. The Rev. Latham Browne has again sent over an hundred moths collected at Thayetmyo by him, many of these are new to the collection Major Bingham has presented the museum with five rare moths and three butterflies, besides a collection of beetles lately collected in Maulmain.

RECENT INVENTIONS.

The following list has been compiled especially for the SCIENTIFIC NEWS *by Messrs.* W. P. THOMPSON *and* BOULT, *Patent Agents, of 323, High Holborn, London, W.C.; Newcastle Chambers, Angel Row Nottingham; Ducie Buildings, Bank Street, Manchester; and 6, Lord Street, Liverpool.*

HORSE SHOE.—A horse shoe has been patented by Messrs. R. Lamb and J. Surthenbank. It is formed of metal, and is fastened to the hoof and to the shoe already upon it by means of suitable devices. This second shoe has in it spikes or projections which prevent the horse from slipping, and may easily be placed upon or taken off when desired without disturbing the ordinary shoe.

TEA.—A method of preparing tea has been patented by Mr. H. Jackson. By the use of this invention the astringent quality known as "tannin" is neutralised or destroyed. It is carried out by spraying over the tea a solution consisting of water and a suitable proportion of carbonate, and then drying it so as to evaporate the water, leaving the alkali on the tea. This has the desired effect.

BOATS.—A collapsible boat has been patented by Mr. C. Henderson. The object is to construct boats so that they may be stowed over each other in great quantities under the present launching appliances on the decks of vessels and without taking up more room than hitherto required. The frames of the boat are jointed to their gunwales and to fore and aft sides at the keel. These longitudinal moving sides allow the frames to slide in a fore and aft direction, and the gunwales to fall in a perpendicular manner; the boat thus collapses, and may be folded down to a horizontal position.

FUEL.—An artificial fuel has been patented by Mr. W. H. Nevill. This invention utilises the inferior sorts of fuel such as breeze, small anthracite, and other inferior fuel or hydrocarbons. To any of these substances is added pitch prepared by adding to it in a boiling state ordinary silicate of soda, after which it is allowed to set and then crushed for mixing with the above substances. This mixture is heated to produce an intimate admixture. While so heated common coal tar in a boiling state is added. The entire compound is then well mixed, then placed in moulds and subjected to pressure, after which it is ready for use.

ELECTRIC CIRCUITS.—An apparatus for detecting and localising faults in alternate current electric circuits has been patented by Mr. W. P. Thompson, on behalf of Mr. G. Westinghouse. The invention consists in placing two electric converters in circuits which may be completed from the respective poles of a generator with the earth, and in applying to each an indicating device, such as an incandescent electric lamp, included in their respective secondary circuits. In case there is a ground connection with one of the lines, the converter connected with the corresponding line will be short-circuited, and the consequent variation in the light will indicate that such false connection is made.

SODA.—An improved manufacture of soda has been patented by Mr. J. B. Thompson. The invention consists in reducing the whole of the sulphide solution to neutral carbonate by heating the solution as soon as bicarbonate has been deposited, which decomposes the bicarbonate into neutral carbonate and carbonic acid, and this acid reacts upon the residual sulphide, producing neutral carbonate and hydrogen sulphide, which passes off and leaves in solution neutral carbonate only. The form of carbonator consists essentially of a series of discs mounted on a spindle, the discs having been cut down and twisted into the whorls of a continuous screw, and has an arrangement of pipes and cocks for the gas and solution.

SECRET WRITING.—A method of secret writing has been patented by Mr. M. A. Weir. The method can be applied to any type-writing machine, and may be carried out as follows:—The machines are in duplicate, so that the two index scales correspond in the arrangement with each other, but differ in the arrangement of the characters from any other pairs of machines. Each machine is capable of writing in cipher. The index scale pointer and type are made moveable, so that they may be shifted out of their correct position, thus when writing with the machine the characters which the operators appear to be writing are really different. In deciphering it is only necessary to shift the movable parts in the opposite direction, and then, by printing the characters of the secret communication, the correct one will be printed.

ELECTRIC BELL INDICATOR.—An indicator for electric bells has been patented by Messrs. A. Morley and H. W. Wilson. The core for the electro-magnet is made of malleable cast-iron in one casting, with an angle bracket for fixing it in place, and with a taper flange at each end of core; it has also a flange for affixing a spring which carries the armature. This casting is japanned, which serves for insulation. The core is wound with silk-covered wire. An indicator is combined with the armature, and is of the usual disc form, and at one end of a double-armed lever where it has a notch that catches over a peg on the armature, the fulcrum screw for the lever being at the end of the casting, and the other arm of lever having an eye with a half-twist. This eye connects it to a re-setting bar. As the keeper is attracted the disc is released from the peg and falls down until stopped by a stop thereon coming in contact with a part of the casting.

ELECTRIC CIRCUITS.—An apparatus for making and breaking electrical circuits in connection with alarm boxes has been patented by Mr. F. T. Schmidt. The periphery of the wheel secured on the "click wheel shaft" of the call box is divided into separate parts, each part having projecting pins corresponding to the number of the box, and an arm extending from the shaft. At the central station is fixed a similar apparatus, but having the distance from the periphery of each part to the centre varying, by which means the electric current is diverted from one local magnet to another. When a signal is sent from an alarm box, the electric current sets in motion the apparatus at the central station, connected to two local magnets which operate dial pointers for actuating a needle, by which a revolving disc controlled by a clock is pierced in a manner so that the time and number of district from whence the signal was sent is indicated thereon in addition to the number being given by the pointers.

CORRESPONDENCE.

The Editor does not hold himself responsible for opinions expressed by his correspondents, nor can he take notice of anonymous communications. All letters must be accompanied by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

A SAFE INSECTICIDE.

Referring to the notice in your columns of to-day of the application of sulphate of copper as an insecticide, it is stated in the first Annual Report on the injurious and other insects of the State of New York, by J. A. Lintner, the State entomologist, that "Sprinkling with a weak solution of blue vitriol, one ounce to a pail of water, kills many kinds of larvæ." In the exhaustive account which is given in this volume of the remedies for insect depredations known in the United States, the safety of the application is regarded; and virulent poisons, such as blue vitriol, require extreme caution in their manipulation.

The sulphate of iron, which is probably the most fatal of any chemical to the smaller forms of insects, is so harmless to human life that five grains are given as a dose, and minnows are unaffected by a solution of eight grains of this sulphate in a gallon of water. Vol. xiii. of the Professional Papers of the Corps of Royal Engineers, contains an account of the destruction of aphides, micro-organisms, and those more recently discovered forms of life to which the phenomena of putrefaction are now attributed, by a very weak solution of iron; and where the destructive enemies of plant life are too large to be thus rapidly destroyed, the solution still acts as an andidote to their attacks, as few, if any, insects will approach a vegetable that has been watered with a solution of iron.

The simplest mode of obtaining a stable solution of iron for the use of the garden or greenhouse is to draw it off from the cup of the ferrometer. This is an instrument for household purification, which is described in the professional paper cited. It is manufactured by Messrs. Filmer and Mason, of Guildford; is now in use at Windsor Castle, Buckingham Palace, Hatfield House, Albury Park, and a number of other places. The perfect sweetness of the dwelling-house is the main result of the use of the instrument; but the subsidiary value for the garden and greenhouse is not to be despised. FRANCIS R. CONDER, M. Inst. C.E.

Guildford, Sept. 22nd, 1888.

STRANGE ACTION OF A BEETLE.

I was amused at reading of the beetle's strange conduct, for I happened to be acquainted with a man of science who acts exactly in the same way. He goes round and round so many times a certain piece of ground to take a constitutional, and when he has accomplished a certain number of rounds he knows that he has walked a certain number of miles. The *one eye idea* (see SCIENTIFIC NEWS Sept. 7th) I should hardly think sufficient to account for it, but in *Nature* I remember reading some account of an American experiment in walking blindfold. Often people have one leg a little shorter than the other, and in this case the tendency is to walk when blindfolded, in the direction of the shorter leg.

The beetle's strange conduct *might* have something to do with this, but I do not think so. It is probable that insects are much more intelligent than we generally suppose them to be. A READER.

THE SATELLITES OF MARS.

There is a paragraph in your journal for September 14th, page 279, in which the theory of M. Dubois is mentioned, but I think there are very few astronomers who will give it their adhesion. The satellites of Mars, instead of being captured planetoids, very probably date their origin from a period coeval with their primary. This conclusion is upheld by the analogies of the solar system. Bode's law of planetary distances is, we know, exemplified in a remarkable manner, and there also appears a definite law in regard to the number of satellites. They increase, in duple proportion, according to their distance from the sun thus:

Earth.	Mars.	Jupiter.	Saturn.
1	2	4	8

Uranus and Neptune would probably further bear out this law, could we view them with greatly increased telescopic power, for the known satellites of these remote members of our system form but a small proportion of the whole number of satellites which belong to them. It is probable that Uranus has 16 and Neptune 32 satellites. We are justified in this assumption by the regular increase in the number of moons attending Mars, Jupiter, and Saturn, which is very likely to be extended to the two outer planets of the system. We are probably cognisant of all the satellites revolving round the earth, Mars, Jupiter, and Saturn, but the immense distances of Uranus and Neptune preclude us from discovering any but the most brilliant of *their* satellites. These bodies were evolved or formed as the result of a comprehensive and harmonious scheme, and we are not driven to such an erratic inference that the moons of any of the major planets are due to the capture of planetoids.

A MEMBER OF THE LIVERPOOL ASTRONOMICAL SOCIETY.

FOOD OF THE LEECH.

Can any of your readers inform me of the general food of the common leech? In the ponds which it inhabits it seldom has the opportunity of feasting on blood, and it does not readily attach itself to the skin even when laid on the hand.

Perhaps leeches feed on aquatic plants, as they are often to be found adhering to the stalks of weeds, such as *Alnacharis alsinastrum.* I do not think they ever attach themselves to fishes, as I have sometimes placed sticklebacks in with them without their attempting to fasten. I have never noticed any allusion to their food (when living in ponds) in any book, and should be pleased to know the real facts of the case.

F. P. P.

THE SPARROW *(Passer domesticus).*

In my notes made in 1886 I stated that the large quantity of fine dust found in the nest of the sparrow was not accidental, but placed there intentionally; this appears to be the fact, for I have seen the sparrow collecting the fine dust from the road on pieces of material for building.

By way of leading up to what I am going to say, I may again state that in 1886 I found from 20 to 25 per cent. of infertile eggs, and in 1887 about 30 per cent.; but in the season of 1888 just passed I found the percentage of infertile eggs considerably reduced, and also a very considerable reduction in the number laid, the average clutch being four eggs, whereas in 1887 it was four and a half eggs. I stated in my paper last year that the eggs laid in 1887 were not so highly coloured as those of the previous year, and the infertility greater; but when I made this statement I little thought that colour and fertility were intimately connected; nevertheless it appears to be the case, for the eggs of the season just past, of which I have ninety perfect clutches before me, are most certainly of a darker colour than those of the previous year. I may here state that the odd egg in the clutches just referred to is not so pronounced as it is in the clutches of the two previous years, and its infertility was not greater than any of the eggs of the ordinary type. This accounts for the fact that, as a rule, the more pronounced the odd egg the greater its infertility, and that in the two previous years the clutches bring one half egg larger and of a lighter colour, and with a more conspicuous odd egg, proves that what I said as to the high percentage of infertility in the odd egg about correct.

The discrepancy between eggs and brood of the season just passed appears to have been about 16½ per cent., the average clutch being four eggs, and the average brood three and one-third young birds, against three and one-eighth last year. The general discrepancy is not altogether brought about by the actual sterility of the eggs, but by many of them producing only a weak young bird, which either died in the nest or was turned out to die. This is a fact about which there can be no doubt. Another circumstance which appears usually to assist the general discrepancy between eggs and brood is the delicate texture of the shell of the odd egg, which often gets broken in the nest. I found that by taking two eggs of equal weight from the same clutch, *i.e.*, the odd egg and one other, that the shell of the odd egg was considerably the lighter; again, in a set of four, with a most conspicuous odd egg, which was the largest of the set, the shells when carefully blown were all of equal weight—namely, four grains each. The following gives the size and weight of each egg: ·90 × ·70, weight 60 grains; ·86 × ·66, 54 grains; ·85 × ·65, 51 grains; ·81 × ·61, 45 grains. These figures show how much more delicate the shell of the odd egg is; moreover, when drilling the holes for blowing I found the shell of the odd egg to cut so much more easily. I am informed by those who are well up in rearing poultry that the eggs of the turkey, which are sometimes laid with the colouring matter collected into hard excrescences, making the shell quite rough, are of no use for incubation, as they always get broken before the time for hatching arrives. Some turkeys' eggs I have now before me show the peculiarity referred to, but in a greater degree than in the odd egg of the sparrow.

Having for the past three years paid considerable attention to the habits of the sparrow, I yet fail to understand why it should vary the number of its eggs to produce about the same number of young birds, and why the eggs when more fertile should be more highly coloured is to me an enigma. I occasionally heard of broods of five young birds, all strong and healthy, being found, and one brood of six was reported, although I must say that personally I have not seen more than four good flyers from one nest, but I have seen several nests in which the brood was represented by one, and sometimes two young birds only.

Want of careful observation of the habits of this bird is, I have no doubt, the reason of its receiving so much persecution. There can be no doubt that it does some harm, but I have every reason to believe that it does some good which more than counterbalances. So far as my personal observation goes, it is the best fly-catcher and caterpillar-eater we have, as it stops with us all the year, other fly-catchers paying us a visit only for the pick of our entomological production.

I cannot close these notes on the sparrow without giving an instance of their slow productiveness. A pair of sparrows built their nest in a hole in a tree about ten feet from the ground; three eggs were laid, and two young birds hatched; shortly after these had flown they repaired the nest and again laid three eggs, but this time only one young bird was reared. They again laid three more eggs, and no August 4th there were two more young birds ready to fly. Five young birds for three broods are most certainly not many, and I believe that this is not at all an uncommon occurrence. The foregoing came under my personal observation, so I can vouch for its accuracy.

The average weight of fresh-laid eggs is 46 grs., but I find those taken on rich clay soil, where there is plenty of water, to give a better average than those taken on poor, dry chalk soil; this, I presume, is owing to the birds getting a better supply of insects at the period of nidification.

Royston, 1888. JOSEPH P. NUNN.

ANSWERS TO CORRESPONDENTS.

J. T. GAINE.—We have heard of a similar occurrence before. Probably, although you thought you had made everything secure, you left a portion of the paper without any weight upon it, and the newt was able to push it up and escape.

TECHNICAL EDUCATION NOTES.

UNIVERSITY EXTENSION IN LONDON.—We understand that the Society for the Promotion of University Teaching in London have made arrangements for seventeen lecturers to deliver twenty-nine different courses, many of which are repeated at more than one centre during the coming season. Eight are devoted to Literature, five to History, two to Social Science, two to Art, and twelve to Natural Science, all of them being full courses of ten or twelve lectures, with the single exception of one on Spectrum Analysis, which is to be given at Dulwich. Mr. Churton Collins supplies five of the literary courses, others being given by Mr. J. A. Hobson, Mr. E. J. Macmullan, and Mr. P. H. Wicksteed. Historical subjects are discussed by Mr. T. H. Attwater, Mr. S. R. Gardiner, and Mr. E. L. S. Horsburgh. Mr. Ernest Radford lectures on Art and on Architecture, Mr. G. Armitage Smith on Political Economy, and Mr. P. H. Wicksteed on Sociology. Of the scientific courses, Chemistry is taken by Professor V. B. Lewes, Astronomy by Mr. J. D. McClure and Mr. E. J. C. Morton, Physiology by Mr. Walter Pye and Mr. D. W. Samways, Electricity by Mr. W. Lant Carpenter, Physical Geography by Mr. A. W. Clayden, and Geology by Professor H. G. Seeley.

THE GRESHAM LECTURES.—The lectures founded by Sir Thomas Gresham will be read to the public on the following days in English, at 6 o'clock each evening, in the theatre of Gresham College, Basinghall Street, in the following order:—Physic (Dr. E. Symes Thompson), October 2, 3, 4, and 5; Rhetoric (Mr. J. E. Nixon), October 9, 10, 11, and 12; Astronomy (Rev. E. Ledger), October 16, 17, 18, and 19; Law (Dr. J. T. Abdy), October 30 and 31, and November 1 and 2; Geometry (the Dean of Exeter), November 5, 6, 7, and 8; and Music (Dr. Henry Wylde), November 13, 14, 15, and 16. In consequence of the death of Dr. Burgon, the Dean of Chichester, no lectures on Divinity will be delivered this term.

THE FORESTS OF EUROPE.—The French Ministry of Agriculture has recently issued some interesting statistics respecting the distribution of forest in Europe. The total area of Europe laid out in forest—exclusive of Turkey, Bulgaria, Bosnia, and Herzegovina, omitted in the official statement—is set down at 286,989 million hectares, or about 708,862 million acres; that is, about 18·7 per cent. of the total area of Europe is forest land. In proportion to its total area Great Britain and Ireland has of all countries in Europe the least extent of forest, amounting to only 4 per cent. of its surface, and, in proportion to the number of its inhabitants, enjoys by far the least allotment of forest, amounting to only 0·036 hectare, or 0·089 acres—*i.e.*, considerably less than the tenth of an acre to each inhabitant. The country in Europe next lowest in the forest scale is Denmark, with 4·8 per cent. of forest land, or 0·09 hectare to each inhabitant. That is to say, in Denmark there is an average of between two or three times the extent of forest land to each inhabitant that there is in Great Britain and Ireland. The third of the countries of Europe in the ascending forest scale is Portugal, with 5 per cent. of forest land and 0·11 hectare to each inhabitant—*i.e.*, an average of three times the amount of forest land to each inhabitant of Portugal that is allowed to each inhabitant of the United Kingdom. Holland has 7 per cent. of forest land and 0·05 hectare to each inhabitant, or about one and a-half times as much as to each inhabitant of the United Kingdom. The country in Europe possessing most forest is Russia in Europe, with 200,000 million hectares—*i.e.*, 37 per cent of its whole area and 3·37 hectares to each inhabitant—that is, each inhabitant of Russia in Europe has an average of nearly 94 times the extent of forest land allotted to each inhabitant of the United Kingdom. In its percentage of forest land and the amount of forest to each inhabitant, Sweden, however stands still higher. With 17,569 million hectares of forest Sweden has 39 per cent. of its land in forest, and so 3·84 hectares of forest to each of its inhabitants. Norway, with 24 per cent of its area in forest, allows each of its inhabitants an average of 4·32 hectares forest, or 120 times as much as is allowed to each inhabitant of the United Kingdom. Hungary has 29 per cent. of its area in forest, or 0·58 hectares of forest to each inhabitant. France possesses 9,888 million hectares of forest, or 17·7 per cent. of its total area, and so allowing 0·25 hectares of forest to each of its inhabitants—nearly seven times as much as is allotted to each inhabitant of the United Kingdom.

SALES.

The Charge for Advertisements in this Column is Sixpence for the first sixteen words, and Sixpence for every succeeding eight words. Advertisements for this Column should be received by first post on Tuesday to insure insertion in the following number.

Astronomical Telescope, 9 in. object glass and 4 powers, late the property of a gentleman (deceased).—Apply, JAS. BARNES, Brunswick New Road, Norwich.

To Microscopists.—First-class unmounted objects, Rock and coral sections, 3s. 3d., series of six varieties; 9 doubly stained botanical sections, 18 miscellaneous, 1s. 1d. each series. Full instructions. All mounting requisites. Quality guaranteed. List, stamp.—MASON, 24, Park Road, Clapham, S.W.

8 in. Achromatic Astronomical Telescope, from the observatory of the late John Watson, Esq., F.R.A.S., for sale, a bargain, comprising 8 in. object glass by Wray (cost £140), six eye-pieces and spectroscope by Browning, metal stand, and driving clock, and all fittings, cost about £700, price £150.—H. L. FOX, 121, Bishopsgate Street Within, London.

The Rev. T. W. Webb's 9⅓ in. silvered glass Reflector.—For sale, the reflector with which he made the observations referred to in his book "Celestial Objects for Common Telescopes." The mounting is a Berthon equatorial.—Full particulars on application to W. J. L., 1, Wellington Crescent, Ramsgate.

Amateur Mechanics supplied with Lathes, Drilling, Planing Machines, Castings, etc. Cash, or easy payments.—Britannia Company, 100, Houndsditch, London.

Britannia Co. *Bona-fide* makers of 300 varieties of lathes, and other engineers' tools. Prize medals. Makers to the British Government.

Practical Hints on Electro-Plating, etc. One stamp.—Address HENRIC, 234, Great Colmore Street, Birmingham.

Amalgamating Brushes, Scratch-brushes, Polishing Sand, Calico Mops, Rouge and Crocus Compositions, Nickel Salts and Anodes.—HENRIC, 234, Great Colmore Street, Birmingham.

Do your own Electro Plating and Gilding. System inexpensive. Particulars one stamp.—PERKS, 47, Alexandra Road, Richmond, Surrey.

Watts' Gas Engines, all sizes, from 1½ bore, slide explodes charge, simple. Lists, 3 stamps.—Below.

Watts' Gas Engines, work without noise, are easily made up. Castings supplied. List, 3 stamps.—Below.

Dynamos for plating and lighting, experimental dynamos, electro motors, separate parts, wire, punchings, etc.—Below.

Dynamos, highest efficiency, castings or finished. List, 2 stamps. —WILLIAMS, WATT, AND CO., Belshaw Street, Homerton, E.

Mica or Talc cut for all purposes. Mica chimneys, Mica covers, etc.—C. JOHNSON, 87, New Oxford Street, W.C.

EXCHANGES.

Exchange Notices will be inserted in this Column at the rate of Sixpence for the first twenty-four words, and Threepence for every succeeding eight words. Advertisements for this Column should be received by first post on Tuesday to insure insertion in the following number.

Powerful Electro-Motor, Grigson's pattern, on polished mahogany stand. Exchange for lantern slides, chromatropes, etc., to value 30s.—G. HARRIS, 17, York Street, Nottingham.

Student's Microscope, 2 achromatic powers, in mahogany cabinet, with 2 dozen best mounted slides. Exchange lantern slides to value £2.—G. HARRIS, as above.

SELECTED BOOKS.

A Text-Book on Steam and Steam Engines. For the Use of Students Preparing for Competitive Examinations. By A. Jamieson, C.E., F.R.S.E., Prof. of Engineering, Glasgow Technical College. With 200 illustrations and four folding plates. Third Edition. London: Charles Griffin and Co. Price 7s. 6d.

Kirke's Handbook of Physiology. Twelfth edition. Thoroughly revised and edited by W. Morrant Baker, F.R.C.S., and Vincent Dormer Harris, M.D. London: J. Murray. Price 14s.

The Industrial Self-Instructor in the leading branches of Technical Science and Industrial Arts and Processes. With practical, useful, and technical notes, facts and figures for ready reference. Profusely illustrated by working drawings, designs, and diagrams. In five volumes. Price 7s. 6d. each. London: Ward, Lock and Co.

A Dictionary of Technical and Trade Terms of Architectural Design and Building Construction. Being practical descriptions, with technical details of the different departments connected with the various subjects: with derivations of, and French and German equivalents. Price 5s. London: Ward, Lock and Co.

A Text-Book of Physiology. By Michael Foster, M.A., M.D., LL.D., F.R.S., Professor of Physiology in the University of Cambridge, etc. With illustrations. Fifth and thoroughly revised edition. In three parts. Part I. comprising Book I., Blood—The Tissues of Movement—The Vascular Mechanism. Price 10s. 6d. London: Macmillan and Co.

NOTICES.

The Title Page and Index to Vol. I., now ready, price 3d.

Binding Cases for Vol. I., price 2s. each.

Cases and Binding, Vol. I., including Title Page and Index, price 3s.

Vol. I., bound in cloth, with Title Page and Index, 9s. 6d. —by post 10s.

The Back Numbers of SCIENTIFIC NEWS can be obtained from all Booksellers and Newsagents, or direct from the Publisher, 138, Fleet-street, London, E.C. Price 3d. each, or by post 3½d.

METEOROLOGICAL RETURNS

for the ten weeks ending on Monday, Sept. 24th, 1888. Specially prepared for SCIENTIFIC NEWS from official reports.

	Mean Temperature.	Rainfall.	Duration of Sunshine.
Scotland, East	53·7 degs., being 2·1 degs. below average.	4·9 ins., being 2·4 ins. below average.	327 hrs., being 0 hrs. ... average
England, N.E.	55·0 ,, ,, 2·2 ,, ,, ,,	6·5 ,, ,, 0·2 ,, above ,,	382 ,, ,, 19 ,, below ,,
England, East	57·4 ,, ,, 2·6 ,, ,, ,,	6·6 ,, ,, 0·9 ,, ,, ,,	326 ,, ,, 36 ,, ,, ,,
Midlands ...	56·3 ,, ,, 3·0 ,, ,, ,,	5·9 ,, ,, 0·7 ,, below ,,	313 ,, ,, 24 ,, ,, ,,
England, South	58·4 ,, ,, 1·9 ,, ,, ,,	5·7 ,, ,, 0·0 ,, ... ,,	346 ,, ,, 27 ,, ,, ,,
Scotland, West	54·5 ,, ,, 1·4 ,, ,, ,,	7·7 ,, ,, 2·4 ,, below ,,	307 ,, ,, 30 ,, ,, ,,
England, N.W.	55·9 ,, ,, 2·7 ,, ,, ,,	7·6 ,, ,, 0·3 ,, ,, ,,	318 ,, ,, 10 ,, ,, ,,
England, S.W.	56·5 ,, ,, 2·6 ,, ,, ,,	7·5 ,, ,, 1·4 ,, ,, ,,	380 ,, ,, 34 ,, ,, ,,
Ireland, North	55·8 ,, ,, 2·4 ,, ,, ,,	8·2 ,, ,, 0·4 ,, above ,,	275 ,, ,, 7 ,, ,, ,,
Ireland, South	56·2 ,, ,, 2·2 ,, ,, ,,	6·9 ,, ,, 1·1 ,, below ,,	362 ,, ,, 24 ,, above ,,
The Kingdom...	[illegible] 2·1 ,, ,, ,,	6·6 ,, 0·7 ,, ,, ,,	324 ,, ,, 16 ,, below ,,

Scientific News

FOR GENERAL READERS.

Vol. II. | OCTOBER 12, 1888. | No. 15.

CONTENTS.

SCIENTIFIC TABLE TALK.

By W. Mattieu Williams, F.R.A.S., F.C.S.

All who have reflected on the subject must have been glad to learn that the subject of gas fuel has again been discussed at the British Association. My detestation of English coal fires and their dirty surroundings has been frequently expressed. These heresies have been described as "crotchets," a very honourable epithet, seeing that the wise men of all ages have been called heretics or crocheteers by the—*i.e.*, the others.

Considerable progress has been made in gas heating since the subject was first brought before the Association in 1881, but much more is demanded.

Mr. Dowson has practically proved that fuel gas may be made at very small cost in a small apparatus, and that such gas does admirable work in driving gas engines, and in various factory applications—so far so good, and very good, but this is merely a preliminary step. The great desideratum is a supply of cheap fuel gas that we may use for warming our houses and cooking our food, so that all the dirtiness of coal heavers, coal cellars, coal scuttles, fenders and fire-irons, of smoky chimneys, and soot and dust and chimney sweepers, may be utterly and for ever abolished.

When this is done—as it must and shall be done—London will become a beautiful city, a city in which an artistic architect may follow his vocation. At present it is the metropolis of grimy abominations, dirty-faced streets, dirty public and private buildings, many of them beautiful *underneath*, but all stuccoed with soot, besmeared with black streaks and blotches that conceal and deface the original design.

There is a great deal of very fine relievo work on many buildings, both in the City and West-end—work, which if visible, would vie with the best to be found in Italian or any other Continental cities. Some time ago I suggested to an enthusiastic amateur-photographer that instead of travelling abroad for subjects, he should rise early on summer mornings and take pictures of such works—naming samples. He approved of the suggestion, but on examining the samples perceived at once that the light and shade, upon which such pictures must depend, was all obliterated by soot smears; the stone cherubs are dirtier than the street arabs in the mud below, and the allegorical females would come out in the picture with black eyes suggestive of Tom Cribb and Ben Caunt, rather than goddesses of peace and plenty.

We have not only dirty streets, dirty homes, dirty faces and dirty hands, but the very air we breathe is abominably dirty.

Frankland has shown that the distinctive character of the "London particular," the choking brown fog (which, by the way, is not the exclusive property of London, but is shared by all our large towns), is due to the coating of watery particles with a film of tarry filth produced by the condensation of the hydro-carbon vapours that are poured into the air by the imperfect combustion of bituminous coal. Such products of that barbaric device, that devoutly worshipped national fetish, "The Englishman's fireside," not only renders artistic refinement impossible, but irritates the lungs, and by familiarity with grime, reacts upon the worshippers, and induces no small amount of moral degradation. This is demonstrated by the toleration the dirt receives.

Fletcher, of Warrington, and other manufacturers, offer us gas stoves of admirable construction for both cooking and warming purposes; all that we now want is the gas at such a price as to compete with the cost of coal, in which cost we must include that of dragging coal about the house, of cleaning, chimney-sweeping, and the wear and tear it involves. At present prices of ordinary gas, the cost of a gas fire in an ordinary sitting-room is, hour for hour, between two and three times that of an ordinary open coal fire. In cases where the fire is only occasionally used, it may be cheaper than the coal fire in spite of this difference. It is needless to discuss the prime cost of gas so long as, in London, its supply to a given district is a monopoly.

That picture of the Dowson gas apparatus in the Scientific News of September 21st, inspires hope, as it shows that heating gas may be made on a moderate scale in the back-yard of an ordinary London house, and therefore, that the inhabitants of any given street, or square, or two or three streets combined, may form a small syndicate, make their own gas close to their own back doors, and supply themselves, at cost price, by purely domestic arrangements of main pipe and branches. To cover uncertainties, the charge per 1,000 cubic feet should be a little above cost, and the surplus divided, *pro rata* of consumption, in the form of bonus, as is done by the Northern Co-operative Societies.

There now exists in London some very convenient nuclei for initiating this reform. I refer to the blocks of tall houses that are divided into flats, such as those near to the Palace of Westminster, on the site of old Oxford Market, in the Marylebone Road, and other places. They are compact, and usually under single proprietorship. Surely the enterprising proprietors of some of these blocks might be persuaded to pioneer that most desirable innovation. The fact that the tenants are emancipated from the vulgar cockney prejudice against flats proves that there are reasoning beings that are not afraid of domestic innovations.

The five years' work at the Gloucester Asylum, decribed in Mr. Dowson's paper, is a step in the direction of domestic gas heating. The cost of 8d. for an equivalent of 1,000 feet of ordinary gas settles the economic question, for if we could be supplied at one shilling, nothing but dogged stupidity could prevent the general domestic use of gaseous fuel.

In reference to this subject it is desirable to brush aside the old water-gas fallacy, which still lingers in the mind of some. Water being composed of hydrogen and oxygen, which may be dissociated by heat, and these gases when separated being addicted to such energetic combustion on re-uniting, it has been supposed that we can create abundant calorific energy by the simple dissociation of water, and re-uniting its elements. If such were the case as supposed, the doctrine of the conservation of energy would be a great mistake. But the fact is, that the work of dissociating water by heat demands precisely the same amount of heat as is given out by the reunion of its elements. The case is strictly analogous to the evaporation of water, and the recondensation of the steam. Neither must it be supposed that in passing steam over heated coke or anthracite, and thus obtaining a mixture of carbonic oxide and hydrogen, or in passing air over the same, and thereby obtaining a mixture of combustible carbonic oxide and nitrogen, we create any heat beyond that which is due to the combustion of the fuel that is used for the production of the gas. We actually obtain less by the final combustion of the gas, because some is inevitably lost by radiation and convection in the gas-making apparatus. The advantage consists in the exchange of gaseous for solid fuel, in obtaining our fuel in a form that is so much more manageable, that can be utilised exactly when and where it is wanted in quantities admitting of practically exact regulation, and with little or no labour, and no dirt.

In an ordinary open coal fire, from eight to nine tenths of the heat goes up the chimney to warm the clouds. With a gas fire the proportions are reversed, eight to nine tenths are used effectively as required, and only one or two tenths are lost.

PHOTOGRAPHING A RAINBOW.—Professor H. Kayser, of Hanover (*Naturwissenschaftliche Wochenschrift*), has succeeded in photographing a rainbow from the Rigi-Kulm. He took special precautions, and used dry plate coloured with azaline.

SOME PHOTO-MICROGRAPHIC APPARATUS.

(*Continued from p. 362.*)

IN cases where an uncorrected objective is used, after obtaining the sharpest possible visual focus, the back of the camera must be racked into the position at which it has been determined the actinic focus lies.

When very great accuracy of focus is required, it is best to use, as a focussing screen, a piece of plain glass slightly greased by rubbing it upon the hand, and an adjustable focussing glass, set to focus the ground or greased surface of the screen. Through this the grease globules will be readily seen, together with the image of the object falling on the surface of the glass; and as both lie on the same plane, accuracy and sharpness may be relied upon.

It now remains to substitute the sensitised plate for the focussing screen, and to expose it.

The exposure must of necessity be long, varying according to the colour of the object, the amplification, the volume of light passing through the objective, and the class of plate used. A long exposure is desirable, and with this view, use a medium stop in front of the objective.

The actual exposure is most readily made by drawing out the shutter of the dark-slide, and when it is judged to be sufficient closing it in again. Some people effect the exposure by placing a small cap over the objective, others by placing a piece of card in front of it, and removing and replacing this for the exposure; but in the writer's experience the gradual drawing out of the shutter of the slide does not cause any disadvantage, whilst it is certainly the handiest and safest method. The removal of the cap or card always leaves a chance of interfering with the object on the stage of the microscope. Any light other than that given by the lamp should be prevented from entering the objective. A piece of velvet carefully placed over the stage and tube of the microscope will prevent this.

Such is the apparatus which can be most readily prepared, and the necessaries for which are to be found in most households nowadays.

Specially designed apparatus for the purposes of photomicrography are to be bought, and it may be useful to examine their structure.

In fig. 2 is shown a simple form of photo-micrographic camera designed by Messrs. Watson and Sons, of High Holborn, which can be used with any microscope, all that is necessary in this case being some packing beneath the frame on which the camera slides, in order that the axis of the camera and the optical axis of the microscope when in a horizontal position may coincide.

A base-board, which is detachable, extends to a sufficient distance in front of the camera to admit of a large microscope and lamp, with ample range for the adjustment of the illumination. The microscope and lamp are fitted on to a board which rotates on the top of the base-board on suitable metal centres, thus enabling the operator to turn the microscope and illuminating apparatus free from the camera, and into such a position as he may find best suits his convenience for examining and centering the object, with the assistance of an ordinary eye-piece. The rotating table is fitted with a lock which comes into action when the microscope is moved back into its central position, this ensuring accuracy of position on its return.

The front of the camera is made to slide back from the microscope to facilitate this latter function.

The camera itself has a range of 30 in., and the amplification is obtained by sliding back the focussing screen frame of the camera, which has guides, working in grooves in the framed base, with clamp screws to fix it in any desired position.

A graduated scale is let into the base of the camera whereby the distance between the lens and the focussing screen can be accurately known, and the desired amplification readily calculated.

By means of a rod running along the side of the camera the fine adjustment of the microscope can be actuated from the back of the camera.

Altogether it is a very simple, efficient, and well thought out instrument.

Messrs. J. Swift and Son, the well-known opticians of Tottenham Court Road, are the manufacturers of several very beautiful forms of photographic apparatus. Their latest, which is represented in fig. 3, is novel in several respects.

In this instrument a specially constructed microscope is used. The tube of the microscope being immovable, the stage and sub-stage traverse a strong horizontal bar, by means of rack and pinion motion, by moving which the coarse adjustment is effected.

The bar carrying the stage is fixed to a stout brass plate into which also the short body-tube is fitted, the whole being secured to the vertical front standard of the camera. The fine adjustment is accomplished by means of a milled head which acts on the stage.

The camera is compound, and consists of a conical leather bellows attached behind to a rectangular mahogany o x, and in front to the strong vertical standard before-mentioned, to which the special microscope is also secured. In this apparatus the front end of the camera is absolutely immovable. The back portion of the camera traverses a suitable raised platform or support, to which it can be clamped in any required position.

To centre the illumination and the object on the stage, the camera is closed up to the microscope as far as it will go, and a board, into which is centered a brass fitting to take a microscopic eye-piece, is fitted into the grooves, which receives the dark-slide. The camera is thus made to form the body-tube of the microscope, and on inserting an eye-piece the object on the stage can be examined with comfort; everything being satisfactorily arranged there, the camera is extended, and the focussing done as usual.

The whole apparatus is mounted on a mahogany base, and is very light and portable.

(To be continued.)

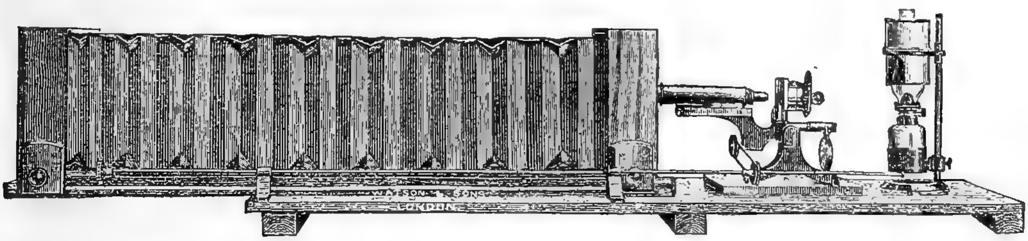


FIG. 2.

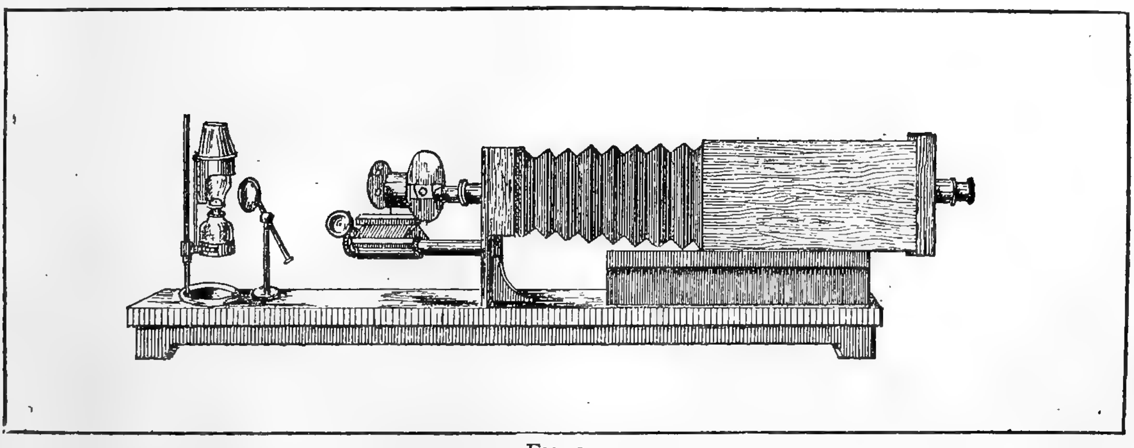


FIG. 3.

THE ANCIENT INHABITANTS OF THE CANARY ISLANDS.

A PAPER READ BY MR. J. HARRIS STONE, M.A., BEFORE THE ANTHROPOLOGICAL SECTION OF THE BRITISH ASSOCIATION.

(Continued from page 359.)

THE narrative of the conquest by Jean Bethencourt, a Norman nobleman, is written by Brother Pierre Bontier and Messire Jean le Verrier, priest, "both learned clerks," to give their own estimation of themselves in their own language.

An admirable translation is given by R. H. Major, in one of the volumes of the Hakluyt Society.

In this narrative there is little direct information respecting the ancient Canarians. The priestly narrators devote great space, as was the custom of the time, to religious details and glorifications, and the sad story of the conquest of Peru and Mexico is foreshadowed. Yet withal that Bethencourt himself managed to endear himself to the natives. He personally seems to have been a judicious and capable man. The natives were a loving, as well as a long-suffering and simple-minded race. Once, when Bethencourt returned to Lanzarote, after a visit to Normandy, the natives cried out:—"Here is our king coming," and so great was their joy, "that they leaped and danced and kissed each other." The same happened at Fuerteventura. "It is impossible," say the learned clerks, "to describe the joy which they testified, after their fashion; they seemed to fly for joy." And again, when Bethencourt left the islands, never to return, "all the inhabitants were to be seen weeping and lamenting, the Canarians more bitterly than the Normans."

Physically the ancient inhabitants were a fine race of people. This is stated over and over again by the conquerors and other travellers, and, coming from Normans, the statement may be taken at its full value.

Morally, it may be said, they were surprisingly high up in the scale we are accustomed to guage by in these days. In many respects they were the superiors in culture and manners of their conquerors. Their character has been thus succinctly and truthfully summed up by Viana:—"They were virtuous, honest, and brave, and the finest qualities of humanity were found united in them; to wit, magnanimity, skill, courage, athletic powers, strength of soul and body, pride of character, nobleness of demeanour, a smiling physiognomy, an intelligent mind, and patriotic devotedness," and, I would add, great gentleness.

From the skulls which I have examined in collections, and have myself found in their cemeteries, the people apparently possessed good brain-power. From an examination of many hundreds of skulls in the islands, I was struck by the fact that a great many possessed an indentation—about the size of the tip of the little finger—on the frontal bone, generally the left. I saw such indented skulls in Palma, Canaria, and Tenerife, and recently, on examining the collection at the Royal College of Surgeons of England, to my surprise I noticed that, out of the twenty-six skulls there labelled "Guanche," no less than fifteen had this indentation, and no less than ten on the left frontal bone. These indentations were evidently made during life, and after the infliction of the injury the subject appears to have lived in some instances for many years. At present no explanation can be given for the frequency of the occurrence of this indentation. To imagine that these skulls are all of people damaged in battle is to suppose a constant concurrence of circumstances which is well nigh impossible. It would necessitate that the blow was always given by the same weapon, on the same place, and with about the same force, and that, too, not a fatal force. The curiously frequent occurrence of these indentations is not mentioned in the catalogue of the museum, but a few remarks made in the catalogue of the Barnard Davis Collection are worth quoting: "No. 505 is very European in its look, with a narrow face and long aquiline nose." "No. 506 is a small ovoid skull of beautiful proportions, with a fine aquiline nose." The teeth of all these skulls are sound, not decayed, but very much worn, as we might expect from the "gofio" food. In the general remarks in this same catalogue occur the following significant words concerning the skulls: "All agree in being small. They belong to the ovoid division of skulls, that which is the common form among Europeans. The whole series is non-African, and would be classified in Blumenbach's Caucasian division, notwithstanding the Guanche cranium has a certain typical physiognomy which distinguishes it from all others." There was a Guanche mummy once at the museum, but it was divested of its flesh for the purpose of obtaining the skeleton, which is there now, disarticulated, in a drawer. A photograph was taken of it before it was subjected to the boning process, but this could not be traced. The museum also possesses, hid away in the recesses of a

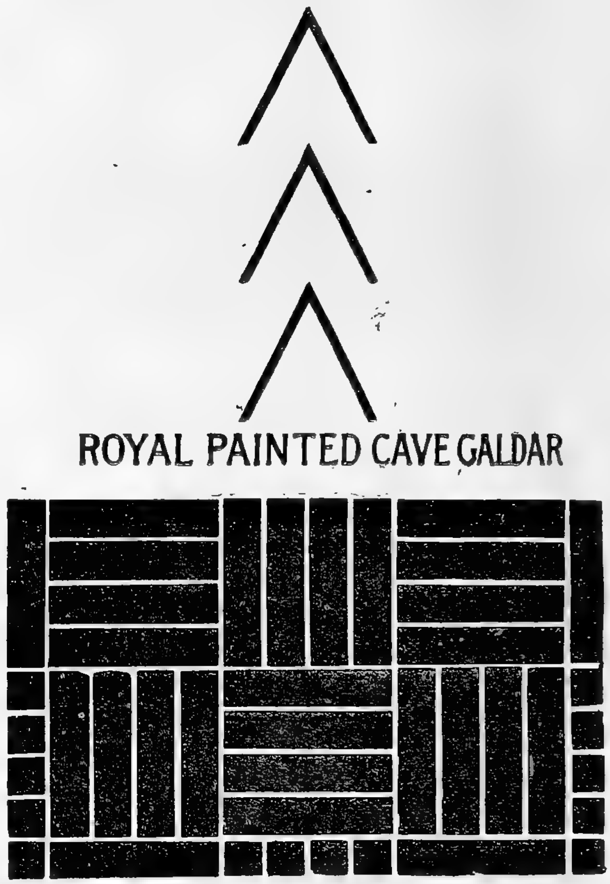


FIG. 2.—ONE-TENTH ACTUAL SIZE.

distant room, at the bottom of a box, specimens of brown, straight hair from a Guanche mummy, found in a cave at Tacoronte, and sent by Don Sebastian Casilda, the founder of the Tacoronte Museum.* The paper containing it is dated 10th March, 1854, and is distinctly greasy—an interesting point, for the Guanches used grease in heir process of embalming. I have seen no black hair belonging to this ancient people. It is always red, reddish-brown, or dark brown. One of the oldest accounts of the people say: "Their long, light hair veiled their bodies down to the waist." The famous, beautiful, and courageous Princess Dacil is distinctly stated to have had fair hair.

* This Museum is, I hear, now for sale. The British Museum should not lose the exceptional opportunity of acquiring the Guanche remains which are there.

The Guanches were good builders of structures made of stones without the aid of mortar. They built a stone wall right across the island of Fuerteventura, separating the two ancient kingdoms of that island. Though much given to living in caves, they also dwelt in stone and wood houses. These were neat and regular in appearance. The roof was composed of rough beams placed close to one another and covered with branches of trees and earth. I saw, and photographed, a good specimen in Gran Canaria from which fig. 1 (page 357) is drawn, and I also measured the interior. The entrance is set back a little, a seat being on either side. The house is rudely circular. It is fifteen and a half feet from the door to the opposite wall. The wall on the left is three feet thick at the bottom, and seven and a half feet high to the beams.

Some of the caves in which the nobles of the people dwelt were elaborately decorated. That of the beautiful Andamana at Galdar, in Gran Canaria, is one of these. When we were there we had this cave partially cleared out of the rubbish which filled it. The entrance way is four feet six inches wide by three feet high The principal cave is nearly circular, and where it could be measured was eighteen feet in diameter. It is possible that the walls sloped upwards, and that at the bottom, if it had been clear of rubbish, it would have been larger. Another cave to the right of this is also painted.

The painting is done in sections, generally running round the cave in widths of ten inches. The designs upon the walls and ceiling, of which figs. 2 and 3 are reduced copies, are in squares like a chess board, white lines being drawn across the squares; then come red circles of two rings, the outer being ten inches in diameter; next are triangles, that fit into each other, the base of one being inside the apex of the other; these are painted alternately black and red. The row beneath is a double-lined zigzag, the points or elbows being at top and bottom. Between the lines, the cave is painted red, but the spaces at the bottom are white Below these are plain squares divided by white lines; the squares are alternately red and black. Two more designs we noticed, one in squares bisected at the angles, the upper half being black and the lower red; and on a stone we saw red lines like inverted V's, one above the other. There are, no doubt, other designs down to the floor, but owing to the rubbish, we could not ascertain the fact. I am glad to say that, in response to vigorous expostulations, this cave has been purchased by the authorities of Galdar, cleared and enclosed, so that future visitors will not experience any difficulty in seeing it.

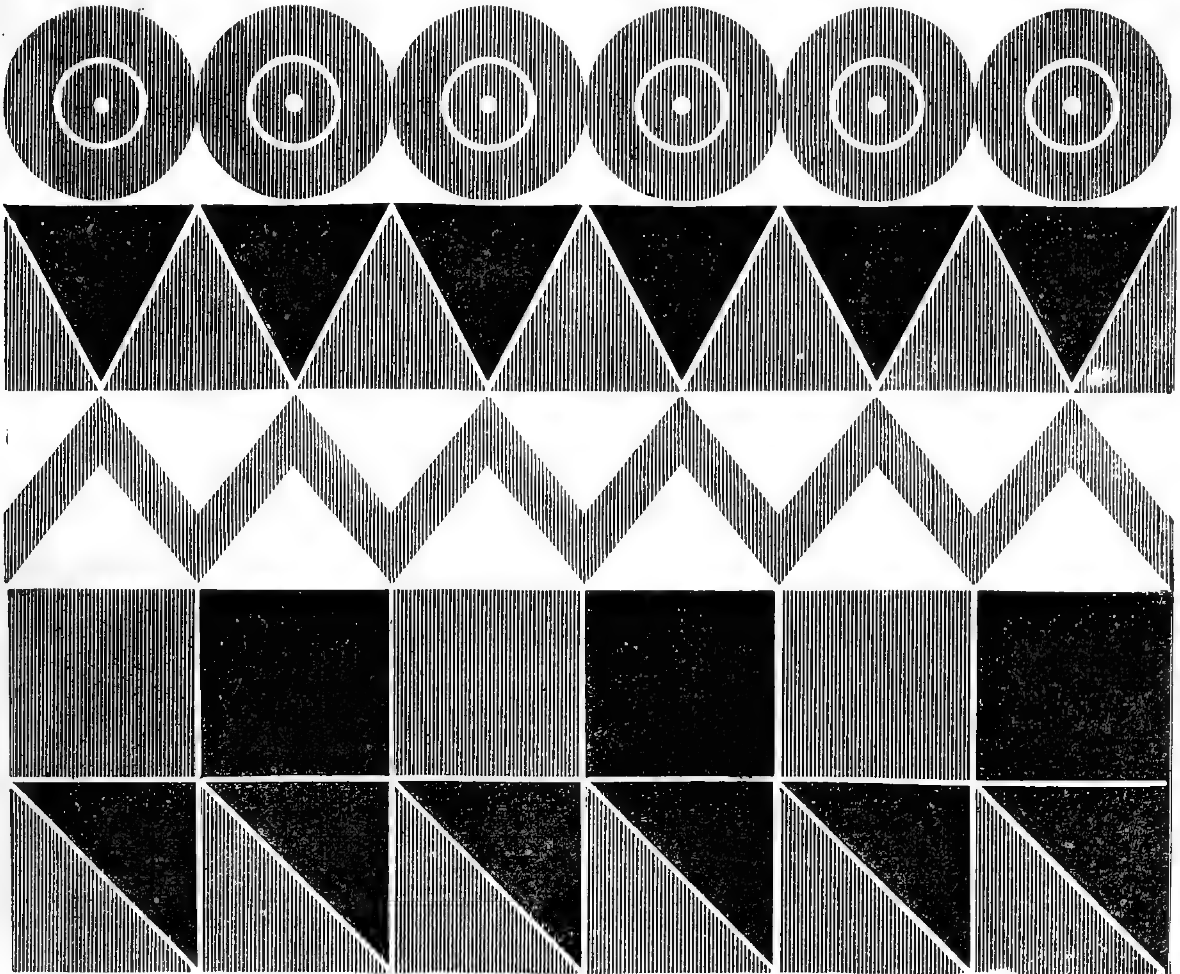


Fig. 3.—ROYAL PAINTED CAVE GALDAR (One-Tenth Actual Size).

(To be continued.)

ON THE STABILITY OF THE FAUNA OF ANY COUNTRY.

(*Continued from p.* 78.)

WHAT circumstances render it possible for a food-species to become very numerous? Above all, as it has been already intimated, great protection. It seems paradoxical to say that the more voracious the devourers—*i.e.*, the larger the minimum quantity upon which they can prolong life, the more numerous becomes the devoured species. A greedy devourer can exist only where great masses of nutriment are available. He begins to die out as soon as the food-species declines in number, and thus the increase of the latter is again rendered practicable. It would be worst for the mice if shrews could increase everywhere freely, and on the the other hand the mice would fare best, and would multiply most rapidly if the lion had to support himself upon mice. Great fecundity affords to a food-species no advantage, their numbers being determined only by the dexterity of the devourer, and the minimum ration upon which he can subsist.

What circumstances allow the devourer to become most numerous? The first condition, as we have already seen, is that he must find hunting as difficult as possible, as he otherwise would reduce too greatly the numbers of the animal upon which he preys; the second condition is high fecundity of such species, so that, if we may use the expression, the capital of food-animals may bring in a high interest. The fecundity of the victim, therefore is an advantage not to him, but to the devourer.

Circumstances take a different aspect when we have to consider not two, but several animals.

Such beasts of prey as feed upon the same species may be called competing devourers, which unite their powers to root out the victims. Those devourers which hold out longest, *i.e.*, which by reason of their skill in the chase, and their power of enduring hunger can still maintain themselves on a very scanty supply of victims will come off victorious. The less skilful and more greedy species perish of want. Whilst, therefore, a beast of prey existing without rivals, finds its advantage in small skill and great need of food; this advantage, in case of competition becomes a grave disadvantage. Nature encounters here a dilemma which she solves very ably. She is continually creating new devourers and equipping them with greater skill in pursuit, so that they may find it possible to rout their old competitors. But now, lest the world should become constantly poorer in individuals, she creates at the same time victims which are more and more skilful in concealment, whereby the success of all devourers is equalized, and that of the new beasts of prey is of course depressed, and the number of individuals is increased. We have thus a race among the devourers which is never ended because the goal, the victim, escapes just as rapidly.

Those food-animals which are decimated by the same enemies may be called fellow-victims. Those which are hardest to catch will multiply most rapidly, and by their great fecundity will support such an army of devourers that all their slower and less fruitful fellow-victims will be rooted out, unless secured by especially favourable circumstances.

The most fruitful and the best concealed species thus eliminate their fellow-victims by the instrumentality of beasts of prey. As fellow-victims are for the most part at the same time competitors (*i.e.*, as the quail and the partridge, both victims of the fox, are competitors on the corn-field) fecundity and concealment benefit a victim in as far as they hinge on the suppression of competitors by rearing a great army of devourers.

What circumstances determine the number of a species? Such number is stable when mortality and fecundity balance each other. Fecundity is heightened by abundant normal food and general comfort, and decreased by every kind of privation. But what determines mortality? The existence of every animal species depends on a number of conditions (temperature, food-plants, dryness, nesting-places, etc.), and where any one of these conditions is in default the species cannot exist. If, *e.g.*, we were to draw up a map of Europe for the capercailzie (*Tetrao urogallus*), marking the places of suitable temperature; on a second map the spots supplying suitable food; on a third, a third condition. We should then find that all the marked places would coincide only at a few spots. For the *urogallus*, Europe is not a continent, but a group of some large islands. For the viper, Europe might thus be called an archipelago of very small islands. Probably many an animal which we regard as rare has reached *in its world* the highest possible number, but this world, in which alone it is able to live, is only a small isolated part of a continent or a sea. From such centres, the species range on all sides as visitors, but without any one forming a permanent settlement.

Within the habitable districts, the existence and the plenty of a species depends especially on its relation to other species, the question being whether the local conditions expose the animal to its enemies, or afford it the opportunity of concealment. We have seen that the greatest abundance of animals will occur where their pursuit is the most difficult. Hence we can understand that certain animals, not dangerous to each other, and dependent on the same conditions, do not co-exist in the same regions or countries, but seem to avoid each other. If two victims have the same enemies, but in district A, Nature favours the concealment of one, but in B, that of another, then in each district the more protected animal will indirectly extirpate the less protected, by increasing rapidly, and thus enabling the devourers to multiply to such an extent that they destroy the other victim. If, conversely, of two devourers which depend on the same diet, here the one and there the other is favoured in the chase by the nature of the ground, then in each case the stock of food animals is depressed to such an extent that the competitor is starved out.

A beast of prey is formidably armed if he can feed upon more species than his rivals. Suppose the devourer, A, lives exclusively upon mice, and requires a stock of 1,000 per square mile, whilst the devourer, B, lives exclusively upon small birds, and likewise requires 1,000 per square mile. If now a fresh devourer, C, makes his appearance in the district, able to live both on mice and on birds, and needing only 1,000 food-animals per square mile, he then reduces the total stock of both mice and birds to 1,000, and thus starves out A and B.

The worst inmates of a district are a beast of prey which devours very many species, and a food-animal which is very fruitful and conceals itself well. As an instance of the latter kind we may take the mouse, but for which we should have a greater variety of small animals. The fauna of any district is the richer the more specialised is the nutriment of the beasts of prey.

General Notes.

Sedimentary Lands and Coal.—According to *Cosmos*, the theory of Fayol that coal-beds are deposits formed by streams at their entry into lakes or into the sea is gaining ground daily.

A Belgian Superstition.—Among the Walloons a meteoric stone is held to be the surest method of discovering a thief. It must be ground to powder, mixed with flour and made into bread, which no thief will be able to swallow.

The Part Claimed by France in the Development of Science.—*La Liberte*, in enlarging on the death of Professor Debray, asks what the Germans and the English would have made of science had it not been for French Rationalism.

The Godwin-Austen Peak.—This mountain, 28,250 feet above the sea-level, and at present reputed the second highest summit of the world, has only just received a name in honour of its discoverer, the first explorer of the Mustakh ranges.

A New Use of Artesian Wells.—In two instances at least, one in San Augustine, in Florida, and the other at Yankton, the ascending column of water from Artesian wells serves to drive various machines, and especially to work dynamos for an electric light installation.

Manchester Scientific Students' Association.—On September 22nd this Association made an excursion to Hayfield, under the leadership of Mr. John S. Pollitt, it being the last excursion of the season. In the course of the walk a number of autumn flowers were gathered.

The Hong Kong Colonial Surgeon on Opium Smoking.—The surgeon, after careful examination, concludes that opium smoking is not to be compared in its evil effects with the European vice of spirit-drinking, a habit to which the Chinese, as a nation, are not given.

A Colossal Raft on the Rhine.—According to *Cosmos*, an immense raft has lately set out from Mainz, on its way to Breeswyk, near Utrecht. It was 220 yards in length, 51 in width, and consisted of 4,000 logs of timber of the value of 500,000 francs. It carried a small village of a dozen huts, destined to accommodate the crew of 120 men.

The Principles contained in Cod-liver Oil.—According to MM. Gautier and Mourgues, cod-liver oil contains six alkaloids, not all of which are salutary. One of them, butylamine, provokes fatigue, stupor, and vomiting. Another, amylamine, is a violent and active poison. Hexylamine is less poisonous, and dihydrolutidine is injurious, occasioning paralysis!

Compressibility of Oxygen, Hydrogen, Nitrogen, and Air.—M. Amagat, in a communication to the Paris Academy of Sciences, shows that under very strong pressures oxygen, nitrogen, and air have almost the same compressibility. At 3,000 atmospheres it is approximately equal to that of alcohol under the normal pressure. The compressibility of hydrogen is almost double.

A Sweeping Sanitary Measure.—The town of Plant-city having been entirely forsaken by its inhabitants on account of the epidemic of yellow fever which had been raging in its neighbourhood, the Hygienic Council of Southern Florida has given orders to burn the city and all its contents. This heroic remedy will, we fear, be of little use unless the mosquitoes could be burnt also.

Hyacinths in the 18th Century.—According to *Le Jardin*, in the last century hyacinths commanded prices similar to those now paid for orchids. A bulb of the variety *Regina vera*, was worth 300 francs. There were four varities which sold at 200 francs each, It must also be remembered in judging of these prices that the value of money was then about four times what it is at the present day.

The Reform of the Calendar.—M. G. Armelin, writing in *Ciel et Terre*, points out not a few irregularities in the established Gregorian calendar. He proposes that the quarters of the year should always begin on the same day, and that in each quarter we should always have a month of thirty-one days, followed by two of thirty, whilst the week should fit in exact with the quarter and with the year.

The New Definition of Steel.—Compounds are now known perfectly free from carbon, but possessing all the mechanical properties of steel. Hence the *Revue Universelle des Mines* proposes to define steel, not as a carbide of iron, but as "a peculiar condition of iron, produced by the union of this metal with bodies the nature of which may vary," and among which rank carbon, manganese, chromium, silicon, and tungsten.

Action of Water upon Pipes of Galvanised Iron.—Messrs. W. R. Nichols and J. K. Russell, of Boston, have undertaken experiments on this question. Zinc was found both in suspension and solution, if the water was allowed to remain in the pipe from 7 to 70 hours. The portion in solution does not increase proportionately to the time, like that in suspension. The layer of zinc deposited on the sides of pipes and cisterns dissolves slowly but continuously.

The South London Entomological Natural History Society.—At the meeting of this Society on September 27th, mention was made of the unusual abundance of the rare and beautiful hawk-moth (*Deilephila galii*) in Britain. Specimens have been taken not merely on the South coast but inland, as well as in Ireland and Scotland. A gentleman present had obtained near Deal 196 of the larvæ. They were feeding chiefly on *Galium verum* (the yellow flowering species). The larvæ varied considerably; some of them, in place of their normal brown or black hue, being of an ochrey colour, or what artists call brown pink. The yellow side-spots were sometimes white and sometimes altogether wanting.

The Sanitary Institute.—The first meeting of the Council of this Society, which has recently been incorporated, was held at the Parkes Museum on Friday last. Sir Douglas Galton, K.C.B., F.R.S., was unanimously appointed Chairman of the Council, and Mr. G. J. Symons, F.R.S., the Registrar. The Institute is founded to carry on the objects of the Amalgamated Sanitary Institute of Great Britain and the Parkes Museum, and it was decided to hold the Institute's first examination for local Surveyors and Inspectors of Nuisances on November 8th and 9th. A programme of lectures for the winter session is in course of preparation. A letter was read from the Charity Commissioners saying that they considered that the new Institute was likely to prove a powerful means for the diffusion of sanitary knowledge, and promising to grant facilities to the Institute to deliver lectures in the various buildings which the Commissioners proposed to establish in different parts of London.

Mexican Agriculture.—In a recent report on the agriculture of the Mexican State of Vera Cruz, the British Consul describes the primitive manner in which maize is cultivated in the Minatitlan district, where three crops are raised annually, but never on the same land. No ploughing is done; one man makes with a pointed stick a series of lines of holes about two feet apart; another man follows, dropping two or three grains into each hole, and the rain is left to fill the holes in. The harvest is calculated at a hundred times the weight of the seed, and is gathered in 16 weeks after the planting. No manuring is done, except when the land is first cleared, and then the ashes of the burnt underwood, rank grass, and stumps are used as fertilisers. This method of cultivation prevails in remote and low-lying districts; on the higher levels maize is cultivated on ploughed lands, and farming there is becoming more and more systematic and on many haciendas scientific. Lack of capital is the cause of the exceedingly rude cultivation of cotton, maize, and other products in Mexico. Even in the case of tobacco many planters never plough or manure, and never plant the same land twice, yet the reputation of Mexican tobacco is rapidly increasing, and the manufacturers of Vera Cruz are increasing the size of their factories and the number of their operatives. The present annual production is almost 6,000,000 lb., produced at an average cost of 5½ per lb. Twenty-three per cent. of the whole is exported, about half of which is manufactured and goes chiefly to England.

Old Roman Plank-Roads.—The Prussian Minister of Education, Von Gossler, having learnt that Professor F. Knoke had lately found traces of old Roman plank-roads on the moor between Mehrholz and Brägel, not far from Diepholz, in Lower Hanover, invited that gentleman to fully investigate the matter. He has just completed the task. He was able to trace the lines of two parallel plank-roads right across the moor, presenting all those distinctive features which are found in Roman works of this kind. One of them shows evident signs of having been demolished by force, the boards, which were originally fastened with pegs to the bearers, having been violently torn away and buried in the bog to the right and left of the track. The other road seems to have fallen into decay, but their are signs of repairs executed even during the Roman period. For in places boards have been found fastened over the original planks, the fashion of both being the same. Those repairs seem to have been carried out hastily, for in one place a mallet, employed probably to drive home the pegs, was found on the track, forgotten, no doubt, by the workmen. The local archæologists feel assured that they have here the *pontes longi* which were used A.D. 15 by the Roman commander, A. Cæcina, in his retreat from Germany to the Ems.

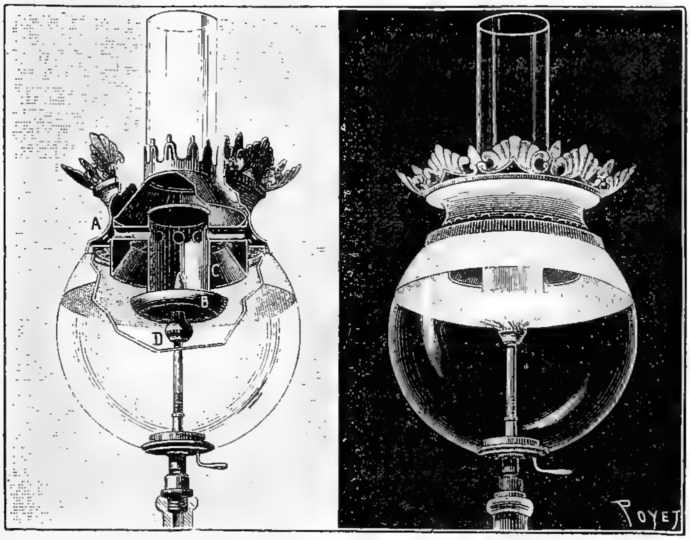
The Atmospheres of the Stars.—Mr. Orray T. Sherman (*Popular Science Monthly*), whilst studying the star-spectra, comprising bright lines, finds that whilst the bright line does not vary in place it may vary in intensity. This peculiarity affords a distinction between bright-line light, bright-background space, and any incidental disturbance the spectrum-light may suffer. Collating his own observations, especially of β Lyræ, with Lockyer's results on the solar atmosphere, he concludes that we may represent to ourselves the condition of the stellar atmosphere and the action therein somewhat as follows:—An outer layer of hydrogen positively electrified, an inner layer of oxygen negatively electrified, and between them a layer of carbon mingling on its edge with hydrogen. The electric spark passing through the mixture forms the hydro-carbon compound, whose molecular weight carries it into the oxygen region, when combustion ensues with the formation of carbonic acid and watery vapour, both of which, descending under the influence of their molecular weight, are again dissociated by heat, and return to their original positions. Under the insight which this result gives, we have found the spectra of the nebulæ referable to low excitation hydrogen, the spectra of the bright-line stars referable to high excitation oxygen and hydrogen, or hydrogen of lower excitation according as the central star is of high or low magnitude. There is also reason for thinking that a similar atmosphere in similar physical conditions lies between us and the sun, and it seems as if we might consider that from the faintest nebula to the most highly-finished star we have but progressive stages of the phenomenon here presented.

The Public Health.—The Registrar-General's return for the week ending September 29th shows that the deaths registered during that period in 28 great towns of England and Wales corresponded to an annual rate of 18·3 per 1,000 of their aggregate population, which is estimated at 9,398,273 persons in the middle of this year. The six healthiest places were Huddersfield, Halifax, Birmingham, Bristol, Nottingham, and Oldham. In London 2,395 births and 1,314 deaths were registered. Allowance made for increase of population, the births were 325 and the deaths 94 below the average numbers in the corresponding weeks of the last ten years. The annual death-rate per 1,000 from all causes, which had been 16·2 and 15·8 in the two preceding weeks, rose again last week to 16·0. During the 13 weeks ending on Saturday last the death-rate averaged 16·2 per 1,000, and was 3·4 below the mean rate in the corresponding periods of the ten years 1878-87. The 1,314 deaths included 30 from measles, 22 from scarlet fever, 27 from diphtheria, 13 from whooping-cough, 13 from enteric fever, 77 from diarrhœa and dysentry, and not one from small-pox, typhus, ill-defined forms of continued fever, or cholera; thus 182 deaths were referred to these diseases, being 34 below the corrected average weekly number. In Greater London 3,158 births and 1,634 deaths were registered, corresponding to annual rates of 29·8 and 15·4 per 1,000 of the estimated population. In the Outer Ring 14 deaths from diarrhœa, seven from diphtheria, and six from scarlet fever were registered. The deaths from diarrhœa included three in West Ham, three in Croydon, and two in Tottenham sub-districts. Three fatal cases of scarlet fever occurred in West Ham, and three of diphtheria in Walthamstow sub-districts.

GAS-BURNER ON THE LEBRUN SYSTEM.

THE apparatus which we (*La Nature*) are about to figure and describe is based on the same principles as the Siemens burner, the Wenham lamp, etc., though its mode of construction is different. Our figure shows the external aspect of the lamp and the principal internal arrangements. It consists of a glass globe, at the lower part of which enters the copper tube (D) conveying the gas. Above this burner is placed a cylindrical cover (C), closed on all sides, but having its lower part (B) pierced with a multitude of small holes, whilst the upper part communicates with the external air by the pipes (A).

The upper part of the globe is closed by a metallic crown; a disc of asbestos interposed between this crown and the globe forms an air-tight joint, so that there is no communication with the external atmosphere except by a glass chimney traversing the crown.



GAS BURNER ON THE LEBRUN SYSTEM.

The lower part of the globe is formed by a trap, which is opened only at the moment of lighting the gas.

The working of the system is easily understood. When the gas is lighted at D and the trap closed the air in the globe is heated and escapes by the chimney. There is thus produced a draught, which forces the external air to arrive by the pipes (A) into the cylindrical cover (C), and to escape by the small holes made in B. Hence it is intimately mixed with the crown of flame of the burner (D), and the combustion is as complete as possible.

The light is very white and very steady, the gas is almost entirely utilised, and for an equal illumination there is a decided economy in the consumption. This burner is constructed of three different sizes, having an illuminating power of 4, 9, and 16 carcels respectively. The apparatus has a screw thread, so that it may be placed in gaseliers, candelabra, etc., instead of the old burners.

It is recommended, *e.g.*, for use in provincial theatres where the expense of an electric light installation is out of the question. Of course the three great objections against gas—the heat, the danger of fire, and the production of sulphurous acid—remain as in the case of ordinary gas-burners.

ON THE PART PLAYED BY SYMBIOSIS IN CERTAIN LUMINOUS MARINE ANIMALS.

THE following communication has been made to the Academy of Sciences of Paris by M. Raphael Dubois:—"In former communications I have been led to admit that the fundamental reaction necessary for the production of light in animals belonged to the class which take place under the action of ferments. In the session of May 12th of the present year, I made known to the Society of Biology the existence, in a normal state, in the walls of the syphon of *Pholas dactylus* of micro-organisms (*Bacillus pholas*), which give a fine light when cultivated in a decoction prepared with the phosphorescent tissues of the living animal. These tissues contain the substance which I have provisionally named *luciferine*, upon which the ferment acts. The reaction requires for the production of light a suitable medium; it must be rendered saline and alkaline in certain fixed proportions. During life the liquid is furnished by the animal, which modifies it as the case requires. It is not the same in the mollusc at rest, which does not shine, as in one which is excited and emits an abundant quantity of the phosphorescent liquid.

We have, therefore, in *Pholas dactylus* a new case of symbiosis, most interesting from several points of view.

I found, in June last, in the mucus secreted by the mantle of *Pelagia noctiluca*, a micro-organism which may be extinguished or rekindled at will by varying the conditions of the medium.

During its changes of physiological activity the *Bacillus pholas* possesses a great morphological fixity. It is not the same with the new organism of the pelagia (*Bacterium pelagia*). If cultivated in gelatine it rapidly excavates funnels filled with a liquefied substance, in which are found abundance of longer or shorter filaments filled with very small spores, perfectly rounded and regularly distributed. They are stained only by Erlich's reagent, and that after some hours. Along with these filaments are found free spores and some movable rods, which become spore-bearing filaments. In pure gelatine these filaments are not luminous, but if they are transferred into liquids of an alkaline reaction, suitably salted and containing phosphorised nitrogenous matter (nucleines, lecithines, etc), they emit a fine blueish phosphorescence in the parts exposed to the air. We find, then, scarcely any filaments with spores or movable rods, but almost exclusively spores.

These luminous liquids obey the same influences as the luminous tissues of phosphorescent animals.

Further, we see in the culture-liquids an accumulation of that characteristic birefrangent substance which forms the chalky layers of the Pyrophori, the Lampyridæ, the Podurae, and which is found in the tissue of the syphon of the pholas, in the epithelium of the digestive tube of phosphorescent myriapods, etc., and the existence of which we have recognised even in the phosphorescent sea-water of the port of Mentone.

This substance, which resembles leucine in certain respects, presents in culture-solutions all the forms which we have met with in the animals studied : fine rounded birefrangent granulations, either homogeneous, or having at their centre a brilliant part representing a vacuole (*Vacuolides*); rounded corpuscules, scintillating in polarised light (sphero-crystals); or small radiating or isolated prismatic needles. We may easily follow all these transformations of one and the same substance, which we have considered as forming one of the elements of the photogenic reaction, when it now seems, according to our most recent researches, to be merely the result.

Along with this product which is deposited in the phosphorescent solutions, as in the organs of luminous animals, we find a considerable quantity of crystals of the double phosphate of ammonium and magnesium, and of carbonate of lime, and in the liquor alkaline phosphates in solution. These phosphates are almost entirely formed by the oxidation of the phosphoric nitrogenous matter contained in the solution. We must admit that these phosphoric nitrogenous matters, though not directly oxidizable in the air, yield, under the influence of the ferment, a substance which possesses this property.

The researches enable us to reconcile the theory of a photogenic fermentation with the hypothesis of the oxidation of a phosphoric matter.

It explains the rôle of the alkaline and saline blood in the acid photogenic tissues of the Elateridae and Lampyridæ, which we have observed without being able to explain. Lastly, we conceive how the phosphorescence of the sea may be produced by the disagregation of marine animals.

NOTES FOR YOUNG COLLECTORS.

(*Continued from p.* 178.)

In our last notes, whilst speaking of rivers in flood as often yielding a harvest for the entomologist, we omitted to call attention to the rubbish which streams deposit along their banks above the ordinary high-water mark after heavy rains. This rubbish consists of grass, straw, twigs, reeds, etc., and often conceals numbers of insects, especially beetles and land and fresh-water shells which have been swept away from the banks, the bushes, and the adjoining fields. The search should not be long delayed, or the insects will have had opportunity to make their escape.

There are various baits, artificial or provided by nature, to which insects resort very eagerly. Among such may be mentioned holes bored into a tree with a large gimlet, so as to set the sap flowing. This is especially attractive in spring and the early part of summer. Excrements of various animals and dung-heaps are often visited not merely by two-winged flies and the so-called dung-beetles of which the species are multitudinous, but by the most beautiful butterflies. A dead rat, mole, or weasel nailed to the stem of a tree at a convenient height is an excellent bait for the "purple emperor" (*Apatura iris*). The gorgeous papilios and ornithopteras of hot climates will come down from the tree-tops to recent human excrement and to over-ripe fruits. Perhaps a half-rotten banana is their favourite lure.

Another trap for a great variety of insects seems quite unnatural, and is yet very successful. It is simply a white cloth spread out on the ground and examined from time to time on both sides, both by day and by night, of course in the latter case by the aid of a lamp. This method of trapping is practicable only either in very unfrequented places or in private enclosures. Elsewhere the cloth will often be found to disappear altogether.

In warm climates it is very necessary to kill all insectivorous creatures which may visit the cloth, such as scorpions, centipedes, tarantulas, galeodes, etc., or they will take the first choice among the specimens.

In waste grounds, especially if sandy, gravelly, or chalky, and covered only with a scanty vegetation, good work may be done by digging holes with a garden trowel, making the sides steep. Insects which do not fly when taking their excursions by day or night get in, and cannot get out again. Such holes should be visited early in the morning.

Many night-flying species, both moths and beetles, can be captured by the aid of lights properly fixed. An electric light, or in its default a powerful paraffine lamp, with a good reflector, is fixed either within a room with open windows or in a verandah. The best situation is an eminence overlooking woods, gardens, or fields, and the best time is the absence of moonlight. The collector waits at hand with his net, and captures the insects as they rush to the light. There are also lamp-traps, which dispense with the net, though not with the attendance of the collector, as if not promptly captured the specimens will damage themselves with fluttering.

A very common method of catching moths, especially of the *Noctua* group, is "sugaring." A part of a tree-trunk, at a convenient height, is painted over with a composition, of which coarse sugar is the principal ingredient. Rum or stale beer is added, to bring the whole to the consistence of a thin paste. On calm, dark nights the collector goes round with a lamp, examines the sugared trees, and dextrously encloses the moths in pill-boxes, transferring them then to the "killing-glass," where they inhale the vapour of cyanide of potassium. Various beetles, even some of carnivorous habits, will also come to sugar. The beetles, if desirable, can, of course, be captured. Spiders occasionally appear, and earwigs in great numbers. They are, of course, treated as poachers, since they frighten away the moths.

In all these various methods of collecting, take care, as far as possible, that you are not watched, especially by boys.

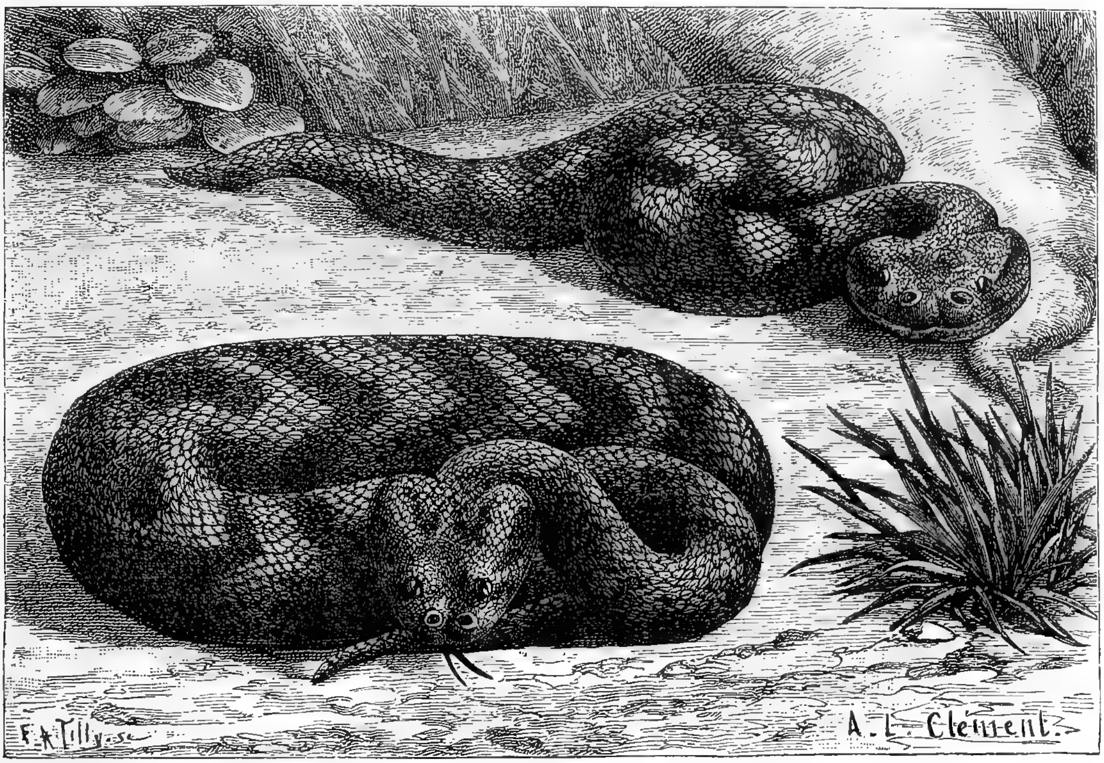
Natural History.

THE PUFF-ADDER.

AFRICA certainly produces neither rattle-snakes, nor bothrops, nor lance-heads (*Trigonocephalus*). But she is by no means deficient in venomous serpents. Not to speak of at least one member of the royal house of the death-snakes, *Naja haje*, she abounds in vipers. The puff-adder (*Clotho arietans*), a figure of which we borrow from our contemporary *La Nature*, and which we are about to describe, inhabits all Africa except the portion to the north of the Great Desert, and is especially abundant along the south-western coasts as far as the Cape. Two fine specimens of this species have been recently brought from Senegambia, and are living in the reptile-house of the museum at Paris. The body of this serpent is short, thick, and squat, and rarely exceeds four feet in total length. It becomes thinner in the region of the neck, and ends in a triangular head with rounded angles, rather heart-shaped, much broader than the neck, and very flat. The tail is conical and short. Its massive and apparently disproportionate form gives it a hideous aspect. The nostrils, which are wide and have a margin devoid of scales, are very near to each other, and are situated exactly above the muzzle, and not at the sides as in several kindred species of the true vipers. Behind and lying outside the nostrils are the eyes, which are at no great distance, on account of the shortness of the muzzle.

As in all vipers, the upper jaw is armed on each side and in front with a set of three to five grooved poison-fangs, highly developed, but unequal. They are moveable, conical, curved backwards, but become erect when the serpent opens its mouth. The channel which traverses them gives passage to the venom, and opens at their anterior edge, near the point, by a long slit. These fangs are extremely sharp, and their conical form enables them to penetrate into the tissues without tearing them. As soon as they are withdrawn from the wound, which is a mere prick, the skin, by its elasticity, returns to its place and imprisons the poison which has been injected, and which is almost instantly carried by the circulation into all parts of the organism. The upper part of the body, including the head, is clad with carinated scales, arranged with much regularity.

The colour of the puff-adder is very variable. In the specimens now in the museum the prevailing colour is a light-brown, verging upon fawn colour. It is relieved on the back by a series of V-shaped marks of a darker colour, opening forwards and generally edged with yellow behind. At the lower part of the sides there is a longitudinal range of dark spots, and the top of the head is crossed at the level of the eyes by a brown band, which descends on each side to the margin of the upper lip.



THE PUFF-ADDER (*Clotho Arietans*).

The puff-adder is excessively slothful, and remains, in general, completely motionless, coiled upon itself, the head resting upon one of its folds. The lower figure in our illustration represents it in this state of repose. Its repugnance to motion is such that it may be almost touched without disturbing itself. It moves only when seeking its food, when attacking or taking to flight, but it then executes rapid movements which contrast with its ordinary sluggishness. If molested, it places itself on guard by withdrawing its head and bending its neck into the form of an S, ready to be shot out like a spring in the act of biting. At the same time the body is alternately swelled out and contracted, and it utters a loud and prolonged hiss. It has the singular habit—whence its specific name—of preluding an attack by striking with its head like a ram.

In a state of liberty this snake preys on rats, mice, and squirrels. In captivity it is fed on rats and on young rabbits. The interval between its meals is on the average twenty-five days.

Making allowance for its slowness in deciding upon an attack, it proceeds much in the same manner as the other vipers. If it finds an animal suitable to become its prey it folds its neck in the manner just described, its breathing becomes more quick and more profound, and it darts out its forked tongue. At last it projects itself, open-mouthed and with the speed of an arrow, against its prey, which it pierces with its long, poisonous fangs. The snake then retreats with the same suddenness, and waits until the venom has accomplished its work. The victim, which seems at first struck with astonishment, quickly falls upon one side as if paralysed, and in the space of a couple of minutes it dies after a few convulsive movements. The serpent then slowly returns, passes its muzzle over the body, which it lastly seizes by the head and swallows.

The venom of the puff-adder yields in nothing to that of the rattle-snake, or rather, we should say, it is the more powerful. Large dogs quickly succumb after having been bitten, and even man cannot always resist its action. It said that the Hottentots use the venom of the puff-adder for poisoning their arrows.

This reptile bears captivity well if kept sufficiently warm; it takes its food regularly, and may be kept alive for years.

Granular Ophthalmia and Flies.—The part played by flies in the transfer of the microbia of tuberculosis has recently, according to the *Revue Scientifique*, been proved in our midst by direct experiment. M. Howe, in a communication to the Congress of Heidelberg shows the *role* of these insects in the propagation of ophthalmia. On visiting Egypt, and remarking the innumerable quantity of flies which settle on the eyes of the natives, led by their indolent nature and by the necessities of mendicity to a complete immobility, we understand how these insects become the real and very frequent cause of the propagation of ophthalmia. M. Howe has likewise verified this fact experimentally by placing flies upon plates of nutrient gelatine, and finding that wherever their feet have touched there are formed colonies of the microbia regarded as the specific germs of ophthalmia. These facts have to be connected with the propagation of the germs of yellow fever by mosquitoes. Further information on the two-winged flies as the colporteurs of zymotic disease will be found in Slater's "Sewage Treatment and Utilisation" (p. 60).

Use of the Antlers of Deer.—At a recent meeting of the Wellington Philosophical Society, Mr. J. W. Fortescue spoke of the rapid increase of deer that have been acclimated in the New Zealand mountains. Having had special facilities for observing these creatures, he proceeded to state some interesting facts as to their habits. At the close of his address Sir James Hector asked Mr. Fortescue, as an expert on the subject, whether the chief use of the antlers was not so much for fighting as for facilitating the progress of the stag through dense woods. He had considerable experience with the wapiti, in North America, and found that by throwing up the head, thereby placing the horns along the back, the animals were enabled to go forward with great rapidity and follow the hinds. He asked this, as it had been stated at a previous meeting of the Society that the antlers tended to entangle the deer. Mr. Fortescue said that Sir James Hector was quite correct in stating that the antlers assisted the stags in penetrating dense forests. Mr. Higginson also bore out this statement from his experience in India.

A Migration of Spiders.—According to *Cosmos* the inhabitants of Abilene (Texas) were surprised to see passing over their heads several balloons, following each other at short intervals. These balloons, when attentively examined, proved to be great cobwebs from which hung down long streamers filled with spiders. Numerous insects, whose organisation seems to render them stationary, are provided with means of transport which explain their sudden appearance at points remote from their place of origin. Birds are thus often the unconscious messengers which convey seeds and small living animals attached to their feathers. Another instance is that of Acari which cling to the body of flies, and are thus conveyed to regions which to them are inaccessible.

A Colony of Beavers on the Elbe.—According to No. 30 of the *Weidmann* for the current year (quoted in the *Naturwissenschaftliche Wochenschrift*), a colony of about thirty beavers have established themselves since the middle of March, above Kanies, near Schœnebeck, on the Elbe, in the province of Saxony, and have sought shelter in the bushes which cover the Elbe embankment. Latterly they have begun to undermine the embankment. Hence it is doubtful if these visitors will meet with permanent toleration. They have been probably driven by floods from their former habitation.

A Parasite of the Cockchafer.—M. Rolland Banès (*La Nature*) has discovered a fungus belonging to the genus *Isaria (Isaria farinosa)*, which takes root upon the living cockchafer and occasions its death. If this fungus can be multiplied, perhaps the number of these destructive insects may be reduced. M. Rolland is of opinion that another parasite (*Cordyceps entomorrhiza*) is developed upon the larva of the cockchafer.

Migration of Wood-Lice.—*Cosmos* records an immense migration of a species of wood-louse not accurately determined, which is said to be now taking place in Pennsylvania. These animals are moving eastwards in millions, travelling by night and in the cool of the morning and evening, and resting by day under stones or in heaps piled upon each other. They do not seem to commit any depredations on their way, and they are not attacked by poultry or by small birds.

Poison of Spiders.—According to the researches of Brieger (*Humboldt*), two spiders regarded in Russia as poisonous, a *Phalangium* and a *Trochosa*, are harmless. A third species known by the Russians as Cara Curt is most intensely poisonous. It occasions damages among cattle which must be estimated by millions. Sheep, oxen, horses, etc., when grazing are bitten in the tongue or the mouth and quickly die. The poison is found in all parts of the spider, even in the eggs. Chemically speaking, this poison, which makes up one-fourth of the weight of the spider ranks among the "enzymes," peculiar, albumenoid bodies which are readily decomposed. If heated to 140 degs. F., or mixed with alcohol, it is rendered harmless. If introduced into the stomach it takes no effect, but if admitted into the circulation that $\frac{1}{10000}$-part of the weight of the body proves fatal to a man or any other warm-blooded animal. It appears to surpass in virulence all poisons except that of serpents. Among the spiders of Germany Brieger finds such a poison present only in *Epeira diadema*, and that only when young.

DEATH FROM THE STING OF AN INSECT.—At Carlisle a man has recently died from a sting in the hand. It is not known whether the offending insect was a wasp or a bee. We evidently do not yet know under what circumstances such stings may have serious effects.

SPECIES OF EMPUSA.—The fungoid genus *Empusa*, and the two small kindred genera *Massopora* and *Basidiobolus* include, in the United States alone, twenty-eight species. As most of them attack and destroy flies, gnats, mosquitoes, etc., they must rank as highly useful. The common *Empusa muscæ* is unusually abundant this season in England, and accordingly dead flies are found attached to the window-panes and surrounded by a halo of the fungus.

BEES AS WEATHER PROPHETS.—Professor Emmerig regards bees as the most trustworthy indicators of weather for the day. If a storm is impending they become restless and irritable, and are even dangerous to approach. When the bees and the weather glasses differ, the insects will be found to be in the right.

THE PRODUCTION OF SILK IN THE WORLD.—The total yield of silk in the world has increased from 9,926 lbs. in 1884, to 11,740 lbs. in 1887. Of this total 4,550 lbs. were last year produced in Europe and 6,430 lbs. in Asia. The production of India was merely the most unsatisfactory quantity of 800 lbs., and Australia, with its great natural facilities for this industry, does not figure in the list at all.

INTRODUCTION OF LOBSTERS INTO THE PACIFIC.—After two unsuccessful attempts to transport living lobsters from the Atlantic to the Pacific a third trial has proved successful. The animals were packed in special cases between layers of sea-weed, and were daily sprinkled with sea-water. Each case contained six specimens. The cases were placed in larger boxes, and the intermediate spaces were filled with broken ice. A special drainage prevented the fresh water from the melting ice from penetrating to the lobsters. On reaching San Francisco 350 were still alive and were at once placed in the sea, half of them to the north and half to the south of the city.

THE SENSES OF BEES.—We have had occasion to mention that bees clearly distinguish beet sugar from cane sugar, rejecting the former. It now appears that not only they but ants and even flies utterly ignore "saccharine," which some human beings think identical in taste to sugar.

CATERPILLARS ON FRUIT TREES.

THE following valuable paper has been issued by the Agricultural Department:—In many of the principal fruit-producing districts caterpillars have lately caused most serious injury to apple, pear, plum, damson, filbert, and other fruit trees, so that in some cases the whole crop has been lost; and it is feared that the fruit-bearing powers of a number of trees have been affected as regards the next season.

As methods of prevention should be adopted during this autumn, and before the winter, with respect to the most destructive species of these insects, it is most important that fruit growers should be informed concerning these at once, and before the appearance of the annual report of the agricultural adviser, to be published in January, which will give full details of the mischief caused by caterpillars, as well as of the history and habits of the numerous species noticed on fruit trees this season, together with remedies against them.

When the blossom buds and leaf buds of fruit trees in many places began to unfold, it was seen that they were attacked by legions of caterpillars. Soon the blossoms and leaves were entirely devoured, or so much injured as to be useless. The fruit plantations in parts of Kent, Hereford, Worcester, and some other counties where fruit is extensively grown, looked as if a hot wind had passed over them.

The caterpillars of various small moths were the authors of this serious mischief. Among these the chief offender was that of the Winter moth, *Cheimatobia brumata*.

Other species did considerable harm, whose life history is much the same as that of the Winter moth, as, for instance, among others, the pale brindled beauty, *Phigalia pilosaria;* the mottled Umber, *Hybernia defoliaria*, and *Hybernia aurantiaria*. These may be placed in one group with regard to the methods of prevention to be adopted against them.

In another group are included the Lackey moth, *Clisiocampa neustria;* the Ermine moth, *Hyponomeuta padella;* and the figure of 8 moth, *Diloba cæruleocephala*, whose caterpillars were more or less destructive this year.

THE FIRST GROUP OF MOTHS DESTRUCTIVE TO FRUIT CROPS.—Methods of prevention are comparatively simple in the case of the first group, because of the peculiarities of the female moths, which are practically wingless, and must, therefore, remain not far from the spots where they have passed their chrysalis stage, and hard by the trees upon which they lived during their caterpillar existence.

They may, therefore, first be destroyed while in the chrysalis condition, which terminates towards the end of October, in the ground around the fruit trees, by digging, hoeing, and the application of caustic substances.

Second, the female moths may be prevented from ascending the trees for the purpose of egg laying by means of bands of cloth or hay, and other obstacles put round the stems.

The Winter moth is taken as the type of the first group, and its life history is briefly described.

The male moth varies in colour from ashy grey to light brown, with dark streaks upon the wings, whose expanse is about an inch. It is about half an inch long. It flies at twilight. Swarms of these insects were noticed last November hovering under fruit trees and quickset hedges, in the foggy evenings, in search of the females.

The female is not quite so long as the male, of the same colour, without wings, having an inelegant, distended body, and might be mistaken for a large spider in the dusk when it comes out and crawls up palings, posts, and the stems of trees. Each female lays from 150 to 200 very small cylindrical eggs, greenish at first, but reddish later on, which she fastens to the buds, or to the twigs and spurs, with a sticky substance.

In the first warm days of spring caterpillars are hatched from the eggs, grey and thread-like in their early life, becoming green with slightly brown heads, and rather yellowish as they approach the pupal period. When full grown they are half an inch long. Having no ventral feet they move like other "loopers," making a loop with their bodies. They glue the petals of the blossoms and the leaves together to form a shelter, and clear off all vegetation within reach, if the conditions are favourable. When they attain the allotted term of caterpillar life, or food fails, or becomes unsuitable, they let themselves down to the ground with silken cords and bury themselves from two to three inches beneath the surface, making cocoons of particles of earth bound together with silk. This takes place usually in the first or second week in June. Towards the end of October the moths begin to appear, and may be seen throughout November and even through December, if the weather is mild.

Methods of Prevention in Orchards.—In orchards, that is, where fruit trees are planted upon grass land, after an attack of caterpillars the grass should be fed off close, or brushed off close. Strong liquid manure may be applied advantageously, or water having paraffin oil in it, towards the latter part of October. Dressings of lime, gas lime, or soot might be put on thickly some distance round the trees.

Lime, or gas lime, or soot, or other pungent materials put on thickly close round each tree, so as not to injure it, would for a time hinder the moths from getting to the trees. It must be borne in mind that the possible area occupied by the chrysalids is some distance beyond the boughs of the trees, so that in old orchards where the trees are very large, putting lime or other substances in lumps close round the trees is the more feasible plan.

After an attack like that of the last spring it is most advisable to take active measures of this kind. Knowing where the authors of the mischief are concealed, fruit growers should take steps to make their summer lodgings as unwholesome as possible. It should be remembered that grass land around fruit trees, being undisturbed, affords shelter also to other insects injurious to fruit crops.

As plants naturally grow towards the light, so the female moths instinctively go up the stems of fruit trees nearest to them as soon as they are transformed. They cannot fly; they must, therefore, crawl up. If they are unscathed by pungent applications, or succeed in getting over circles of hot lime or ammoniacal soot, their progress must be arrested by means of obstacles placed round the trees.

That which is put round trees for this purpose must be fastened very tightly and closely to their stems, so that the moths cannot get under it.

Hay bands dipped in tar, or smeared with tar and cart grease, or with Davidson's composition,* may be used for this. Oilcake bags or manure bags are better, dipped in a mixture of soft soap, without water added, or paraffin oil, or carbolic acid. Calvert's carbolic soft soap would be also applicable for this.

American fruit growers, whose orchards are infested with insects of similar habits, put guards of different constructions round the stems of the trees.

This guard consists of a girdle of tin and stout linen fixed low down round the tree. The linen is sewn to a cord which is firmly and closely fastened round the stem. To the lower edge of the linen a circle of tin is tacked, three or four inches wide, and of sufficient diameter to stand three or four inches from the stem. The inside of the tin is smeared with tar and cart grease, soft soap and paraffin, or carbolic soft soap, or some other offensive, sticky composition, to keep the moths from going beyond the guard. Occasional examinations must be made, and the composition renewed, if necessary, from time to time.

Before the spring comes the bark of the stem below the guard should be well scraped, and soft soap and paraffin, or carbolic soft soap, worked well in with a stiff brush, to remove any eggs which may have been deposited there by moths in despair of finding their accustomed places.

It should be said that these guards ought to be put in working order in August, in order to keep back the caterpillars of the Codlin moth, *Carpocapsa pomonella*, which go up the stems of apple and pear trees, after they have come from the apples which they have spoiled. This caterpillar wriggles up the stem and changes to a chrysalis under the bark. It has done enormous injury this year in most orchards.

* "Davidson's composition" may be obtained of Messrs. Dickson, Newton Nurseries, Chester.

Methods of Prevention on Cultivated Fruit Land (Fruit Plantations).—In addition to the guards and obstacles prescribed for trees upon grass land, it is possible to get at the chrysalids in fruit plantations by thoroughly digging and working the ground all round the fruit trees with spuds and prong hoes in October, as well as by digging in lime, soot, and other caustic substances. After the ground has been dug it should be knocked to pieces by means of prong hoes.

This is especially necessary in the case of filbert and cob-nut trees, as it would not be practicable to put guards round these.

When filbert trees and cob-nut trees have been badly attacked by the winter moth and its allies, they should not be pruned until January, after the eggs may have been deposited. The larger part of these will then be cut away with the wood that is pruned off, which should be removed and burnt.

The bark of apple trees should be to some extent removed from the stems and large lower limbs beyond the fork, and these should be well brushed over with soft soap and paraffin, or carbolic soft soap. Pear, plum, and damson trees should also have their stems brushed with offensive compounds.

The Second Group of Moths Injurious to Fruit Trees.—With regard to the second group of moths injurious to fruit trees, it may be said generally that it is important that the stems and large lower limbs should be denuded of their rougher bark, and rubbed over with soapy or oily compositions, mixed with paraffin or carbolic acid.

In the case of the Lackey moth, its caterpillars change to chrysalids under rubbish, grass, and clods near to the fruit trees they have injured. As they do not go deeply into the ground it is advisable to brush off grass and weeds round the trees, and to rake up and burn all rubbish, also to apply lime and other caustic materials. Digging and hoeing are likely to be very efficacious upon cultivated land.

The female moths of this group can fly, and some of them place their eggs upon twigs and spurs of fruit trees in the summer, where they remain until the spring. It would be advantageous to throw finely powdered quicklime over and up into the trees during the winter after an attack. This should be done in a damp fog, not when there is a drip from the trees, but with merely sufficient moisture to hold the lime upon every part of the twigs and spurs.

For mossy apple trees this treatment is admirable, as it destroys mosses and lichenous growths, which harbour all kinds of insects.

It is obviously more difficult to use means of prevention against the moths of the second group than those whose females are wingless. Fruit growers must depend somewhat more upon remedial measures in their case, and the experiences of the last season have indicated several remedies which proved more or less satisfactory, and will be described later on in detail.

Japanese Copper Mines.—The copper mines of Ashiwo are situate in the mountains, about 30 leagues to the north of Tokio, whence they are easily accessible by railway. They employ no fewer than 4,600 workmen, including those engaged in felling timber as fuel. Coal can only be brought at a prohibitive price, and there is reason to fear that the adjoining forests will soon be exhausted, as they are cut down without system and without replanting. The mines have been worked since the beginning of the 18th century, and until lately have belonged to the Crown, but have lately become the property of an individual capitalist who owns several other mines. In 1886 they produced 4,150 tons of metallic copper, being a yield of about 4 per cent. on the ore. The crude metal is conveyed to Tokio, where it is refined. The ore is slightly argentiferous, yielding from 500 to 1,250 grammes of silver per ton of copper.

Reviews.

Reports of the Scientific Results of the Exploring Voyage of H.M.S. "Challenger." Prepared under the direction of the late Sir Wyville Thomson, F.R.S., and now of Mr. Jno. Murray. Vol. xxiii. : Zoology. I. and II. : Reports on Pteropoda (part ii., Thecosomata; and part iii., Anatomy), by Paul Pelseneer, D.Sc. III. : Report on Hydroida, by Prof. G. J. Allman, M.D., LL.D., F.R.S.S. L. and E., etc.

The above reports on the curious minute molluscs, scientifically known as Pteropoda, but from their shape and movements more popularly termed "winged snails" and "sea butterflies," form the second and third memoirs which Dr. Pelseneer has contributed on this subject to the *Challenger* series, he having dealt with the Gymnosomata, *i.e.*, those Pteropoda which in the adult state have neither a shell nor mantle skirt, in a previous volume ("Zool. Chall. Exped.," part lviii.). In the first report in the present volume the author gives a full systematic description of the other great division of the Pteropoda—the Thecosomata—which in the adult condition possess both shell and mantle. This memoir and the following one are based on a very extensive set of specimens, including, besides the *Challenger's* spoil, those collected by the *Triton*, by Mr. Rattray in the *Buccaneer*, and by the Italian *Vettor Pisani* in its three years' scientific cruise, as well as collections made at Malta by Surgeon D. Bruce, M.B., and by Dr. Pelseneer himself at Naples, a wealth of material rarely available, and of which the writer has rendered ample account. It seems at first sight rather curious to learn that although the *Challenger* specimens were taken from seventy different stations in all parts of the world, and included shells dredged from the deposits of "Pteropod ooze," only one form worthy of a new name was discovered. This ceases, however, to be very remarkable when we find that only forty-two species of Thecosomata exist; indeed, the really striking thing is this small number of species, for the Pteropoda not only occur in all the great seas from Arctic to Antarctic regions, but they swarm to such a prodigious degree that, though of very minute size, they often actually colour the surface of the water for several square miles in the Arctic seas, where they are said to form an important part of the food supply of the Greenland whale.

The Thecosomata, as looked at from the general student's point of view, have left Dr. Pelseneer's hands in a greatly simplified condition—out of a previously possible thirty-four genera he has abolished all but eight, while among the species the slaughter of names has of course been proportionately heavy. Thus the fourteen species of Clio recognised by Dr. Pelseneer, have hitherto rejoiced in six generic and fifty-seven specific designations, and his genus Cavolinia of eight species represents four genera and fifty-four species under old systems of classification. This is indeed something to be thankful for.

The second report (part iii.), which deals with the structure and classification of the Pteropoda, will be of much wider interest than the two previous memoirs. In it the author discusses the comparative anatomy of each genus of both the great Pteropod divisions in as far as the main organs have in his opinion either been hitherto imperfectly understood, or are calculated to throw light on the affinities and systematic position of the group. This part of the work seems to have been carried out with great thoroughness, and, as might be expected, involves many differences of opinion and corrections, as well as confirmations of the work of his predecessors, Souleyet, Van Beneden, Huxley, Fol, Gegenbaur, and others. What may be called the battle of the ganglia is fought at great length, and the partial twisting of the body, on which the proof of affinity to other groups of Mollusca so much depends, receives its share of attention. Perhaps, however, the reasoning in these two questions would have been more readily followed if one or two additional illustrative diagrams or drawings had been introduced. The conclusions of Dr. Pelseneer from these studies are that the Pteropoda are not a branch of the cuttlefish group or Cephalopoda, nor are they a class (of equal value with the latter) of the Mollusca, both of which views have prevailed and still prevail among zoologists, but that they are a subordinate branch of the Gastropoda or snail-like Molluscs. This itself is enough to cause a mild surprise, but we are positively startled to learn that the two divisions of Pteropoda themselves are not at all related to one another as Pteropoda, but that although both are derived from Tectibranchiate Gastropoda, the Thecosomata spring from a family of which Bulla may be taken as the type, while the Gymnosomata originate from a not very distant family represented by Aplysia, the "sea-hare," the modifications in their form arising from the adoption of a life on the high seas remote from land and the consequent necessity of habits of continual swimming.

The Pteropods are thus not a primitive group which has existed without much change from remote periods, but a recent and terminal one. They certainly possess the following characteristics of terminal groups quoted from Prof. Giard. (1) They are profoundly modified in adaptation to a special mode of existence. (2) They exhibit very slight variability. (3) They include a very small number of species. If, however, the Pteropoda are a recently developed group, it may be asked what becomes of Theca, Conularia, Cleodora, Tentaculites, and other Palæozoic and secondary fossils hitherto classed as Pteropods. The answer is short. Dr. Pelseneer ejects them all from the group without hesitation, and recognises no fossil Pteropoda below the Tertiary. In this he is probably right, and on the conchologist and palæontologist, who appear equally to lack his esteem, will devolve the task of finding a new home for the outcasts. It should be mentioned that, as Dr. Pelseneer points out, De Blainville was the first to show the near relationship of the Pteropoda to the Gastropoda, and that his views have been since supported by Souleyet, Spengel, Grobben, and Boas. As no classification can now be accepted which lacks the aid of embryology, it is to be hoped that this test will shortly be applied to the views so ably expounded by Dr. Pelseneer. It is, perhaps, worth pointing out that on page 88, fourteenth line from the top, the perplexing word "Aplysoidea" is evidently a misprint for "Thecosomata."

III. The Report of Prof. Allman on the Hydroida deals with the Tubularinæ, Corymorphinæ, Campanular næ, Sertularinæ, and Thalamophora; the Plumularinæ and Hydrocorallinæ having been already described, the former by Prof. Allman and the latter by Prof. Moseley ("Zool. Chall. Exp.," part vii.). It is divided into two parts, the first being a complete "Exposition of Hydroid Morphology from the standpoint of our present knowledge," and the second a description of the various genera and species collected in the expedition. Thirty-nine splendid plates drawn by the author and Miss M. M'Daniel, a map giving the track of the *Challenger*, and tables of the geographical and bathymetrical distribution of the specimens taken on the voyage, add greatly to the beauty and usefulness of the volume. The wide geographical distribution of some genera, such as Sertularia, which is found in nearly all parts of the globe, from Britain to Cape Horn, and the varying depth at which others are dredged, as Cryptolaria from near the surface and a tropical temperature in Mid-Pacific down to depths of over three miles at 34°, prove how these apparently delicate organisms can adapt themselves to extreme conditions of temperature. One giant of seven feet in length, Monocaulus by name, the most remarkable Hydroid obtained in the cruise, was brought up from a depth of 2,900 fathoms, or nearly four miles.

What Dr. Allman modestly styles a "Sketch of Hydroid Morphology" is a remarkably clear and simple, and at the same time, as might be expected from one who is *facile princeps* in this department, able and complete exposition of the structure and development of the group as at present known. Lack of space prevents us from referring at further length to this interesting division of Prof. Allman's work, but we may add that a description of the curious genus Myriohela, and of its aberrant embryonic changes, forms an important section of this part of the memoir, which is worthily ended by a clear tabular classification of the chief Hydroid groups.

TOTEM CLANS AND STAR WORSHIP.

A Paper Read by Mr. George St. Clair, F.G.S., before the Anthropological Section of the British Association.

A TOTEM may be described as the badge or crest of a clan or gens, owned and used by all the members of the clan, and serving to distinguish them from members of other clans in the same tribe or in other tribes. It is commonly of an animal form, such as a bear, wolf, turtle, etc., and may be tatooed on the body or inscribed on the shield, or put forward in other suitable ways. Those who use such a crest—as bear or wolf—call themselves bears or wolves, or sons of the animal. They regard the animal as their ancestor, sometimes as their creator and god, and often show some religious reverence for it. They shrink from killing and eating the animal after which they are named, while they have no objection to killing the sacred animal of their neighbours. They credit stories of men having been changed into animals, and in some instances they look forward to a similar transformation for themselves after death. Totemism is thus seen to be connected with the doctrine of the transmigration of souls. It is also connected with the practice of exogamy, or marriage out of the clan; for it is a general rule among barbarians that no man is to marry a woman of the same totem-crest or clan-name with himself. The existence of totemism is almost universal among the natives of Australia, among the Red men of America, and is widely prevalent in Asia and Africa; while its former existence among the early Arabs, and the ancient Greeks and Egyptians can be shown.

These are the principal facts, and as some of them have no appearance of necessary connection, the meaning of them has proved difficult to fathom.

I have been led to connect the clan divisions with divisions of the year and periodical duties; and, through the seasons and months, with the constellations of the months, and the animal forms of the constellations.

Beginning with a small community, which has its camp to guard, and perhaps its religious tabernacle, let us suppose that the eldest son of every mother is liable to military service. As the guard need not be too numerous, the camp is divided into four quarters, and the young men serve in turn for a fourth part of the year. In larger tribes the division may be into twelve, a number suggested by the fact that the year is already divided into months. The religion of the tribe is astral, like that of the ancient Chaldeans, and the watchers know what constellations are uppermost in the various months. If the first band finds the bull constellation in high heaven in the dead of night during its month, it will reverence the bull; the young men will return to their tents at the month's end and speak of the bull; they will remember that when the bull is next in the ascendant they will have to do duty again; and will come to be known as the bulls. For the like reason others become goats and scorpions, or kangaroos and blacksnakes, according to the names of the star-groups with different peoples. The bulls tattoo themselves with the bull crest, and carry it as a military ensign. The members of the bull clan become known as the bulls, or are designated by the equivalent expression, "sons of the bull," the bull is said to be their father, the father of the clan, their great ancestor, and is not to be used as food. But no sooner is the original tribe thus divided into twelve clans, than a great danger threatens its existence, and the integrity of its worship. In the first instance, the whole tribe reverenced all the host of heaven, and was interested in the rise of each zodiacal constellation in turn; but now they are becoming separately enamoured of special gods. The good object of the division into clans was to divide labour and to protect the whole community from outsiders; but the result threatens to be to convert the tribe into so many antagonistic clans. For the division into twelve, or into four, was local and territorial, and the clans thus formed and kept apart are now coming to have separate interests. It is therefore mutually consented, that no man shall take a wife from his own clan, though he may go to either of the other three or eleven. It is already the custom of society that children are reckoned to their mother's kin; and so this new rule of exogamy ensures that no son shall ever be of the same clan as his father, while every clan must see its daughters dispersed among every other throughout the tribe. Thus, notwithstanding the twelve clan divisions and the twelve special gods, provision is made for preserving the integrity of the original tribe, as far as barbarian statesmanship can do it. This is a brief synthetical statement of the system, as I regard it, and of the logical connection between the several features of totemism.

Against this view there is the preliminary objection that barbarians would not be advanced enough to frame a religious and social system upon an astronomical basis. Frazer says it is remarkable how small a part is played in totemism by the heavenly bodies. . . . . A star or constellation appears only twice (pp. 25, 26). But in the same connection he allows that the sun occurs as a totem in Australia, Africa, and America, and on another page (30) he quotes Indians who painted the moon as well as the sun, and divers birds and beasts as totems upon their shields.

Mr. Dawson, a writer who is credited with understanding the Australian aborigines, assures us* that "their knowledge of the heavenly bodies greatly exceeds that of most white people, and is taught by men selected for their intelligence and information." But are barbarous tribes influenced by sentiments of religion and worship? They are, for Mr. Morgan, in his profound work on "Ancient Society," tells us that "after the fashion of barbarians the American Indians were a religious people. The tribes generally held religious festivals at particular seasons of the year, which were observed with forms of worship, dances, and games."† The preliminary objection, therefore, founded on the supposed ignorance and irreverence of early men, is met and removed.

The *Journal of the Anthropological Institute* for August, 1888, containing further important notes on the Australian Class Systems, by Mr. Howitt, only reached me after the present paper was finished and sent in. Mr. Howitt, like all other writers, confesses that "to explain the rise of totemism is as yet one of the unperformed tasks of anthropology." He is apparently as far as possible from imagining an astronomical origin. Yet he supplies facts which lend the strongest

* See A. Lang, "Custom and Myth," p. 126.

† "An cient Society." By Lewis H. Morgan, LL.D.

confirmation to my views, only the facts are scattered, and require to be rightly allocated.

To begin with his conclusions: "The class systems of Australia have been developed from the original division of a community into two exogamous groups." Over very extensive districts "the meaning of the two primary class names is almost everywhere Eagle-hawk and Crow." Native names for Eagle-hawk and Crow are *Bunjil* and *Waa*. "Bunjil is one of the fixed stars, probably Fomalhaut." "A native legend recounts how Bunjil left the earth with his sons and ascended to the sky in a whirlwind. Woiworung astronomy points out where they now are. Bunjil is Fomalhaut, and as my informant said, 'He is looking at what men are doing.' The 'sons' of Bunjil are all stars of the southern hemisphere, and all come into one quarter of the circle, with Fomalhaut—the brightest star in *Piscis Australis*—at one extreme. I should have expected them to extend over half a circle, with Fomalhaut midway; and when I observe that the native informant gave only six stars as sons of Bunjil or Fomalhaut, and placed five of them by the fingers of his left hand, saying that this was usual with his tribe, I suspect that some stars of the other quarter circle are counted as sons of Bunjil*; and that the lost clan stars of Waa occupied the remaining semi-circle (with the star Alphard, *cor Hydræ*, as the parent, equivalent to Waa).

Further confirmation of the astronomical origin is afforded by the diagram, which Mr. Howitt's native informant made by arranging sticks upon the ground. There were thirteen sticks, all radiating from a centre, their directions determined by the sun, and number one placed in a direction due east. The unequal angles of the others can be best understood by supposing that they indicate the meridians of stars. "The direction in which the sticks pointed indicated how the individual was to be laid in his grave." Nine of the sticks represented the principal totems of Krokitch, which was only one of the primary classes out of two; but in the diagram the entire nine occupied scarcely more than half a circle.

Next "we find among the Iroquois six annual religious festivals, which were common to all the gentes united in a tribe, and which were observed at stated seasons of the year. Each gens furnished a number of 'Keepers of the Faith,' both male and female, who together were charged with the celebration of these festivals."† Here at least we have among barbarians public duties, probably of a combined military and religious character, and a conscription of persons to perform them. This reminds us of the Hebrew arrangement, in which the Levites performed duties partly military and partly religious in connection with the tabernacle.‡ Before these duties were devolved upon the tribe of Levi alone, they were performed by contingents from all the twelve tribes,§ and when the change was made, the rebellion of Korah, Dathan, and Abiram showed that much dissatisfaction was felt at the apparent usurpation. Henceforth the tribe of Levi served as substitutes for the eldest sons of all the tribes,|| for each of whom they received a redemption price of five shekels. The High Priest stood as the representative of all the twelve tribes; he wore their names upon his shoulders,¶ and upon his breast the twelve precious stones which were representative of the twelve months of the year and the zodiacal signs.** At a later period, when the work of the Levites had become more specialised as religious work, a national militia was organised by David, in twelve regiments, one from each tribe, to serve monthly.†† The description of the Israelitish camp in the wilderness shows us the twelve tribes in four groups—north, south, east, and west of the tabernacle. In marching, the groups are headed severally by the tribes of Reuben, Judah, Dan, and Ephraim, each carrying a standard. What these ensigns were we are informed by Aben Ezra, and in the Targuin of Jonathan Ben Uzziel, Reuben carried a bull, Judah a lion, Dan an eagle or a basilisk, and Ephraim a man. Taking the basilisk as equivalent to a scorpion, these four signs also head the four quarters of the zodiac; and it is worthy of note that while the bull is the first of the zodiacal signs in the ancient writers, and the lion is always fourth from the bull, Reuben was the first-born son of Jacob, aud Judah his fourth son.

Frazer tells us (p. 81) that when a North American tribe is on the march, the members of each totem clan camp together, and the clans are arranged in a fixed order in camp, the whole tribe being arranged in a great circle, or in several concentric circles. When the tribe lives in settled villages or towns, each clan has its separate ward. In Mexico there were four divisions of the army, which were drawn from the four phratries of the people;* and Morgan tells us that Herrera, after mentioning a chapel of lime and stone for the idol, says that the idol gave orders for the division into four wards, leaving itself in the middle.

If we regard the division into four as being based on the seasons of the year and the quarters of the heavens, we see how very natural it is, and how likely to have been suggested independently to the men of different continents. Nearly all the towns or tribes of the Aztecs were divided into four clans, or quarters, whose chiefs constituted the great council. They were of separate lineage, and had distinguishing standards and costumes, and went out to war as separate divisions. The Munniepores, and the following tribes inhabiting the hills round Munniepore—the Koupouees, the Mous, the Murams, and the Murring—are each and all divided into four familes, which may not intermarry with those of their own name.

If the division into four is based on the four quarters of the year, and of the heavens, there is one arrangement which is simpler still, and that is a division into two, representing summer and winter, or light and darkness, the upper and the under sky. Plutarch tells us that the Persian twelve were classed as six of the Light and six of the Darkness. The Australians have a grand classification of all things in nature into two phratries. The eagle and crow in their myths were continually at war, like the Persian Ormuzd and Ahriman. The same eagle and crow are constellations, and at the same time progenitors of the human race, and as creators they divided the Murray Blacks into two classes.† Again, with the Australians, the sun, the summer, the wind, and the kangaroo, etc., belong to one grand division; the moon, the winter, the rain, the alligator, etc., belong to the other. But a time came when the two great phratries had to be subdivided, and now nearly all the tribes consist of four classes—for instance, Ippai, Kubbi, Murri, and Kumbo—two in each phratry, and each marrying into the opposite phratry. The Seneca-Iroquois are divided into two phratries of four gentes each. They recognise a Great Spirit and an Evil Spirit, besides a multitude of inferior spiritual beings. Both in America and Australia we may notice that when the divisions are more than four, they are apt to be eight or twelve or sixteen, which are multiples of four. Among the Altarians in Siberia we find twenty-four sections, each having its own patron divinity and religious ceremonies. In most instances these larger numbers may have been arrived at by subdivision of the clans; but in the case of the number twelve, the division of the year into months would lend its aid as a determining cause.

(*To be continued.*)

THE RAIN IN LONDON.—According to Dr. W. J. Russell, the rain which falls in the City contains twice as much impurity as that falling simultaneously in the suburbs.

* "Canst thou guide Arcturus with his sons?"—Job xxxviii. 32.

† Morgan, 82.

‡ See Stanley's "Jewish Church."

§ Exod. xxiv. 5, 9. Kalisch on Levit. i., 396. Judges, xvii. 5; Judges i. Compare for useful suggestion A. D. Tyssen's pamphlet, "Origin of the Week Explained."

|| Kalisch on Leviticus i. 358, 376; note 398.

¶ Kalisch i. 356.

** These twelve stones represented, according to Clement Alexandrinus, the twelve signs of the zodiac (Strom. i. 5. Drummond, 228).

†† 1 Chron. xxvii. 1.

* Morgan, "Ancient Society," 98, 198, 203.

† Frazer, 83; A. Lang, "Myth and Ritual," ii. 4; Wake.

Abstracts of Papers, Lectures, etc.

SOCIETY OF ENGINEERS.

At a meeting held on October 1st, Mr. A. T. Walmisley, president, in the chair, a paper was read on "Light Railways," by Mr. William Lawford, M. Inst. C.E.

The paper first drew attention to the fact that the subject was not a new one, having been brought before other scientific bodies about twenty years ago, and also that since that period very little appeared to have been done with Light Railways, in this country at least, and that amongst those that had been constructed, few, if any, had proved commercially successful. The author endeavoured to show the reasons for this, and contended that up to the present time they had scarcely had fair play shown them, and that greater facilities for construction should be granted by Act of Parliament. He then showed that, comparatively speaking, the so-called "Railways Construction Facilities Act" was not made much use of; the ordinary Act of Parliament, notwithstanding its additional cost, being evidently preferred.

The development of steam tramways and road railways was then brought forward, and the term "Light Railways" properly defined, and the latter was exemplified by a description of the Wotton Tramway constructed for the Duke of Buckingham and opened for traffic in 1871.

The author next introduced the subject of break of gauge, as many light railways have been made on a less than the normal gauge of this country, which necessarily involved a break of gauge; this was exemplified in the case of the Festiniog Railway, which has a two feet gauge; and the opinions of some engineers of eminence were given on the gauge question.

The suggestions of the Report of the Commission on the Depression of Trade was shown to have some bearing on this question, from the fact that Light Railways or steam tramways would be the means of greatly assisting the transport of agricultural produce generally, so as to bring it rapidly and cheaply to market, the assumption being that such districts as those alluded to might bear the expense of making and working a Light Railway, whilst the population was too sparse and too widely scattered to support a railway of heavy or ordinary construction.

Certain light railways in Russia, known as the "Maltzeff" railways, were alluded to, but all that is known of them is that their cost is barely one-fifth per mile of the ordinary heavy lines in that country, and that they pay an annual surplus profit of $3\frac{1}{4}$ per cent. on the cost of construction.

The conclusions arrived at were that if light railways can be made to pay their promoters in other countries, why should they not do so in this? And the author gave it as his decided opinion they had not yet had fair play accorded to them.

ENTOMOLOGICAL SOCIETY.

At the meeting held October 3rd, Mr. Poulton exhibited a larva of *Smerinthus ocelatus* feeding on nut-leaves. He finds that if the larva of this species has lived for some time upon willow leaves it will starve rather than eat nut leaves. But if it finds itself upon nut leaves, on emerging from the egg it accepts the strange food. Mr. Poulton showed the importance of this principle in accounting for the spread of moths and butterflies in new countries.

Major Elwes exhibited an interesting collection of butterflies captured this summer on a journey from Mexico to California. Many of the specimens were rare, and some probably new to science. He discussed the phenomena of seasonal and climatic di- or polymorphism. In the very difficult genus *Colias* ("clouded yellows") he gave an instance of two apparently distinct forms obtained from the same brood of eggs, both being *unlike* the parents. The speaker recommended the eastern side of the Rocky Mountains up as far as the 60th parallel of latitude as a happy hunting ground for entomologists, which is by no means thoroughly explored.

Among the exhibits were a damaged specimen of *Daphnis nerii* (the oleander hawk-moth) found in a street of Burton-on-Trent, a collection of Longicornes from New Guinea, and a huge moth sent by Mr. Oliffe, of the Sydney Museum. This species has the fore-wings resembling those of a *Saturnia*, whilst the hind wings approach those of *Hepiolus*. The female of the species measures 10 in. across the wings.

Mr. Poulton read a very suggestive page on the ontogeny of the larvæ of *Sphinx convolvuli* and *Aglia tau*, which have never before been closely examined in their earlier stages. The most important point established was that *Aglia tau* has very remarkable affinities with the *Sphingidœ*, and connects the latter family through the *Saturnia* group to the *Bombyces*.

Falmouth Naturalist Society.—The annual meeting of this Society was held on Tuesday, 2nd Oct., the president, Mr. Howard Fox, occupied the chair. The hon. secretary, in the annual report, said that there was much cause for gratification, on the completion of this the first year of the society's existence, although little practical work had been done, yet there was every reason to believe that what had been done would prove of value and be productive of good results. During the session ten papers had been read before the society, including "Some Notes on British Plants," by Rev. A. R. Eagar, B.D.; "Cragside, Northumberland," by Mr. Howard Fox, F.G.; "Conchology," by Rev. C. Crawshaw; "Sun Spots," by Rev. Wm. Rogers, M.A.; "Seven Days in the Bermudas," by Mr. F. J. Stephens; "Persecuted Birds.—I. The Owl," by Mr. H. C. Oakshott; "Bees, and Bee Keeping," by Mr. John Gedge, jun.; "Dragon Fies," by Mr. W. H. Bath, of Birmingham. During the session twelve ordinary and six field meetings had been held, all of which had proved very successful, and were well attended. The financial state of the Society was very satisfactory, a balance of several pounds being in hand. The Rev. A. R. Eagar, B.D., was elected President for the next session; Messrs. A. Pendarves Vivian, F.G.S., W. L. Fox, F.R. Met. Soc., and Howard Fox, F.G.S., were elected vice-presidents. A long discussion followed as to the best means of increasing the usefulness of the society, and many valuable suggestions were made. It was resolved that a conversazione should be held in the Town Hall on Tuesday 23rd inst. A large number of microscopes, collections of specimens, curiosities, etc., had been lent, and the meeting hoped that it would prove successful. The first ordinary meeting for the session will be held on Monday 15th inst., when the Rev. A. R. Eagar will read an opening address.

THE ELECTRICAL TRANSMISSION OF POWER.

A Lecture Delivered by Professor Ayrton, F.R.S., etc., before the British Association, on September 8th, and Re-Delivered to the Working-Classes of Bath, on September 13th, 1888.

(Continued from p. 370.)

A VAST district in London, extending from Regent's Park on the north to the Thames on the south, from the Law Courts on the east to Hyde Park on the west, has over 20,000 incandescent lamps scattered over it, all worked from the Grosvenor Gallery in Bond Street by means of alternate current transformers, which convert the 2,000 volts contained between the street mains into 100 volts in the houses; and this London Electric Supply Company have arranged for a vast extension of this system to be worked from Deptford.

In America alternate current transformers are due to the remarkable enterprise of Mr. Westinghouse, used to light 120,000 incandescent lamps in 68 towns. In fact, the electric lighting of a whole town from a central station begins to excite less astonishment than the electric lighting of a single house did ten years ago.

The efficiency of a well-made alternate current transformer is very high, being no less than 96·2 per cent. when the transformer is doing its full work, and 89·5 per cent. when it is doing one quarter of its full work, according to the experiments made by our students. It certainly does seem most remarkable, and it reflects the highest praise on the constructors of electrical machinery, that motor power can be converted into electrical power, electrical power at low pressure into electrical power at high pressure, or electrical power at high pressure into electrical power at low pressure, and lastly, electrical power into motor power in each case with an efficiency of 94 per cent.

As a further illustration of the commercial importance of this electric transformation, I will show you some experiments on electric welding, one of the latest developments in electrical engineering. To weld a bar of iron one square inch in section requires a gigantic current of some 13,000 ampères. To convey this current even a few yards would be attended with a great waste of power, consequently while an enormous current is passed through the iron to be welded, only a comparatively small current is transmitted along the circuit from the dynamo to the welding apparatus. Mr. Fish, the representative of Professor Elihu Thomson, of America, to whom this apparatus is due, will be so kind as to first show us the welding together of two bars of square tool steel, the edge of each bar being three-quarters of an inch, and the operation is entirely completed in some fifteen seconds. For this experiment an alternate current of 20 ampères will be produced by the dynamo at the other side of the lower Bristol road, and this current will be converted by the transformer on the platform into one of 9,000 ampères, large enough for 12,000 of those incandescent lamps, if these were placed in parallel and the current divided among them. He will next try welding some thicker bars; and lastly, he proposes welding together two pieces of aluminium, which it is extremely difficult, if not impossible, to weld in any other way. The bars, as you see, are in each case pressed together end on, and, in consequence of the electric resistance of the very small gap between the bars being much higher than that of the bars themselves, the current makes the end of the bars plastic long before it softens the whole bar. Hence a very good weld indeed can be made by end pressure.

Did time allow, I should like to describe to you what perfection the system of economical distribution with accumulators originally proposed by Sir William Thomson in 1881, and shown in its very simplest form in the wall diagram, has been brought by Mr. King, the engineer to the Electrical Power Storage Company, how the cells when they are fully charged are automatically disconnected from the charging circuit and electrically connected with the discharging circuit, how the electric pressure on the discharging or house mains is automatically kept constant, so that the brightness of the lamps is unaffected by the number turned on, and how cells that are too energetic have their ardour automatically handicapped and not allowed to give more current than is being supplied by the less active ones.

During the last few months fierce has been the battle raging among the electricians, the war-cry being alternate current transformers *versus* accumulators, while the lookers-on with that better view of the contest that they are proverbially said to possess, have decided that the battle is a drawn one. Neither system is the better under all circumstances; if the district to be lighted be a very scattered one, use alternate current transformers by all means, but if the houses to be lighted are clustered together at a distance from the supply of power, then the storing property possessed by accumulators, which enables the supply of electric power to far exceed the capacity of the dynamos and engines in the busiest part of the twenty-four hours, will win the battle for accumulators. Any direct current system of distribution such as is furnished by accumulators has also the very great advantage that it lends itself to the use of the very efficient electro-motors which I have been using this evening. Alternate current motors do exist, but they are still in the experimental stage and are not yet articles of commerce.

Secondary batteries have caused much heart-burning for their uses, from the apparent fickleness of their complex chemical action, yet but imperfectly understood. But we have at length been taught what is good and what is bad treatment for them, and after years of brave persevering application on the part of the Electrical Power Storage Company, that forlorn hope, the secondary battery, has become one of the most useful tools of the electrical engineers, and secondary cells, some of which, thanks to the kindness of that company, I am using here to-night to supply power for lamps and motors, may now be trusted to have a vigorous long life. That company, I learn, undertake henceforth to keep their cells in order, when used for central station works, for 12½ per cent. per annum, and I understand that they have such confidence in them that they anticipate making no little money by incurring this insurance office responsibility. It is not then surprising that the Chelsea Supply Company have decided to use secondary batteries on a large scale for the economical distribution of light and power in their district.

Oliver Goldsmith said more than 100 years ago in his life of Richard Nash, Esq., "People of fashion at Bath. .... when so disposed attend lectures on the arts and sciences, which are frequently taught in a pretty, superficial manner so as not to tease the understanding, while they afford the imagination some amusement." I want not to be superficial, yet I must not tease your understanding, and so we will not lose ourselves in technical details. If, however, my remarks have led you to appreciate the vast economical importance of using very large electric pressures, and to grasp that by substituting 2,000 volts for 50 volts when transmitting a certain amount of electric power the current can be reduced to one-fortieth part, and the waste of power when transmitted along a given length of a given wire to the 1-40th of the 1-40th, that is to the 1-1600th part, your imagination will have been kindled as well as amused.

With a loss on the road of only 11 per cent. M. Deprez has, by using 6,000 volts, transmitted 52-horse power over a distance of about thirty-seven miles through a copper wire only 1-6th of an inch in diameter. A piece of the actual conductor he employed I hold in my hand; the copper wire is coated with an insulated material, and then with a leaden tubing, so that the outside may be touched with perfect impunity, in spite of the high potential difference employed. M. Deprez's dynamo and motor were not nearly as efficient as he could make them now, so that his terminal losses were unnecessarily great, and the efficiency of the whole arrangement, wonderful as it was, was not so startling as it would otherwise have been. I have told you that the loss in dynamo and motor has actually been reduced to only 12½ per cent., so that if a dynamo and motor of this efficiency had been used by M. Deprez the total loss in the whole transmission over thirty-seven miles would have been under 25 per cent. Indeed, by using only 1,250 volts Mr. Brown has succeeded in transmitting 50-horse power supplied by falling water at Kriegstetten to Solothun in Switzerland, five miles away, with an entire loss in the dynamo, motor, and the five miles of going and returning wire of only 25 per cent., so that ¾ of the total power supplied by the water at Kriegstetten was actually delivered to machinery at Solothun, five miles away.

In less than twenty years then from Gramme's practical realisation of Pacinotti's invention we have power transmitted over considerable distances by electricity with only a total loss of 25 per cent., whereas the combined loss in an air pump and air motor, or in a water-pump and water motor is 40 per cent., irrespective of the additional loss by friction or leakage that occurs *en route*. We cannot help feeling that we are rapidly arriving at a new era, and that it will not merely be for the inauguration of the quick transmission of our bodies by steam, or the quick transmission of our thought by telegraph, but for the economical transmission of power by electricity, that the Victorian age will be remembered.

I showed you a little while ago an electric fire. Was that a mere toy, or had it any commercial importance? To burn coal, to work dynamos, and to use the electric current to light your houses and your streets is clean and commercial; to use the current to warm your rooms clean but wasteful, on account of the inefficiency of the steam engine. But when the dynamos are turned by water power which would otherwise be wasted, the electric current may be economically used not merely to give light, but also to give heat. And when the electric transmission of power becomes still more perfect than at present, even to burn coal at the pit's mouth, where it is worth a shilling a ton, may, in spite of the efficiency of the steam-engine being only one-tenth, be the most economical way of warming distant towns where coal would cost twenty shillings a ton. Think what that would mean, no smoke, no dust, a reform effected commercially which the laws of the land on smoke prevention are powerless to bring about, a reform effected without the intervention of the State, and, therefore, dear to the hearts of Englishmen.

I am aware that this idea of burning coal at the pit's mouth and electrically transmitting its power has quite recently been stated to be commercially impracticable. But is that quite so certain? for in 1878 it was stated that, although telephones may do very well for America, they certainly would never be introduced into Great Britain, as we had plenty of boys who were willing to act as messengers for a few shillings a week. The phonograph was also declared to be worked by a ventriloquist, and electric lighting on a large scale was proved to be too expensive a luxury to be ever carried out.

To-day the electric current is used for countless purposes; not only is it used to weld, but by putting the electric arc inside a closed crucible, smelting can be effected with a rapidity and ease quite unobtainable with the ordinary method of putting the fire outside the crucible. If one had pointed out a few years ago that it was as depressing scientifically to put a fire outside a crucible when you wanted to warm the inside, as Joey Ladle, the cellarman, found it depressing, mentally, "To take in the wine through the pores of the skin instead of by the convivial channel of the throttle," who would have believed that, in 1888, a 500-horse power dynamo would be actually employed to produce an eletcric arc inside a closed crucible in the manufacture of aluminium bronze? Putting a conservative drag on the wheels is a good precaution to take when going downhill, but it is out of place in the uphill work of progress.

But of all the many commercial uses to which the electric current may be put, probably, after the electric light, electric traction has most public interest. The English are a commercial people, but they are also a humane people, and when, as in this case, their pockets and their feelings are alike touched, surely they will be radicals in welcoming electric traction, whatever may be their political sentiments on other burning topics of the day. It is not a nice thing to feel that you are helping to reduce the life of a pair of poor tramway horses to three or four years; it would be a very nice thing to be carried in a tramcar for even less fare than at present. Now, while it costs 6d. or 7d. to run a car one mile with horses, it only costs 3d. or 4d. to propel it electrically. Indeed, from the very minute details that have recently been published of the four months' expenses of electrically propelling thirty cars at seven and a half miles an hour along twelve miles of tramway line in Richmond, Virginia, it would appear that the total cost, inclusive of coal, oil, water, engineers, firemen, electricians, mechanicians, dynamo and motor repairers, inspectors, linemen, cleaners, lighting, depreciation on engine, boiler, cars, dynamos, and line work has been only 1¼d. per car per mile. This tramway is no doubt particularly favourable for propelling cars on the *parallel* system (that is the system in which the current produced by the dynamo is the sum of the currents going through all the motors on the cars) without a great waste of power being produced by a very large current having to be sent a very long distance, because the tramway track is very curved and the dynamo is placed at the centre of the curve with feeding wires to convey the current from the dynamo to all parts of the track. But even in the case of a straight tramway line with a dynamo only at one end, it is quite possible to obtain the same high economy in working by employing a *large* potential difference and by sending a small current through all the trains in *series* instead of running the trains in *parallel* as is done on the Portrush, Blackpool, Brighton, and Bessbrook tramways.

This *series* system of propelling electric trains was, oddly enough, entirely ignored in all the discussions that have taken place this year at the Institution of Civil Engineers and at the Institution of Mechanical Engineers regarding the relative cost of working tramways by horses, by a moving rope, and by electricity; and yet this series system is actually at work in America, as you will see from an instantaneous photograph, which I will now project on the screen of a series electric tramway in Denver, Colorado; and a series electric tramway 12 miles long, on which 40 cars are to be run, is in course of construction in Columbus, Ohio. The first track on which electric trams were run in *series* was the experimental "Telpher Line," erected in Glynde in 1883, under the superintendence of the late Professor Fleeming Jenkin, Professor Perry, and myself, for the automatic electric transport of goods. The large wall diagram shows symbolically, in the crudest form, our plan of series working; the current follows a zigzag path through the contact pieces, and when a train enters any section the contact piece is automatically removed and the current now passes through the motor on that train instead of through the contact piece. The Series Electrical Traction Syndicate are now developing our idea, but it has received its greater development in the States, where the Americans are employing it instead of spending time proving, *à priori*, that the automatic contact arrangements could never work.

In addition to the small waste of power and consequent diminished cost of constructing the conductors that lead the current into and out of passing trains, the series system has another marked advantage. Some years ago we pointed out that when an electric train was running down-hill, or when it was desired to stop the train, there was no necessity to apply a brake and waste the energy of the moving train in friction, because the electric motor could, by turning a handle, be converted into a dynamo, and the train could be slowed or stopped by its energy being given up to all the other trains running on the same railway, so that the trains going downhill helped the trains going uphill—the stopping trains helped the stopping trains. At that time we suggested detailed methods of carrying out this economical mutual aid arrangement, whether the trains were running on the parallel or on the series system. But there is this difference, that whereas on the parallel system it is only when a train is running fairly fast that it can help other trains, the series system has the advantage that, when a motor is temporarily converted into a dynamo by the reversal of the connections of its stationary magnet, the slowing train can help all the other trains even to the very last rotation of its wheels.

Brakes that save the power instead of wasting it are purely English extraction, but their conception has [re]cently come across the Atlantic with such a strong [Y]ankee accent that it might pass for having been born [an]d bred on the States.

Economy is one feature that gives electric traction their [ri]ght to claim your attention, safety is another. This [mo]del telpher line worked on the *post head contact* [sys]tem is so arranged that no two trains ever run into [on]e another, for in addition to each of the three trains being provided with an automatic governor which cuts off electric power from a train when that train is going too fast, the line is divided into five sections connected together electrically in such a way that as long as a train is on any section A no power is provided to the section B behind, so that if a train comes into section B it cannot move on as long as the train in front is on section A. Whenever a train—it may be even a runaway electric locomotive—enters a blocked section it finds all motive power withdrawn from it quite independently of the action of signalmen, guard, or engine driver, even if either of the latter two men accompany the train, which they do not in the case of telpherage; no fog, nor colour blindness, nor different codes of signals on different lines, nor mistakes arising from the exhausted nervous condition of overworked signalmen can with our system produce a collision. Human fallibility, in fact, is eliminated while the ordinary system of blocking means merely giving an order to stop, and whether this is understood or intelligently carried out is only settled by the happening or non-happening of a subsequent collision, our automatic block acts as if the steam were automatically cut off, nay, it does more than this, it acts as if the fires were put out in an ordinary locomotive and all the coal taken away, since it is quite out of the power of the engine driver to re-start the electric train until the one in front is at a safe distance ahead.

The photograph now seen on the screen shows the general appearance of the Glynde line, which has recently been much extended in length by its owners, the Sussex Portland Cement Company, and a telepher line with automatic blocking on the principles I have described is about to be constructed between the East Pool tin mine, in Cornwall, and the stamps. There will be four trains running, each consisting of 33 skeps containing 3 cwt. each, so that the load carried by each train will be about five tons.

It may be interesting to mention that the last difficulty in telpherage, which consisted in getting a proper adhesion between the driving wheel of the locomotive and the wire rope, has now been overcome. The history of the telpher locomotives is the history of steam locomotives over again, except that we never tried to fit the electric locomotives with legs, as was proposed in the early days for steam locomotives. It is a tedious, discouraging history, but it is so easy to be wise when criticising the past, so difficult to be wise when prospecting the future. Gripping wheels of all kinds, even the india-rubber tires used for the last three years have all been abandoned in favour of simple, slightly loose, cheap iron tires, which wear for a very long time, and give a very perfect grip when the bar supporting the electro-motor is so pivoted, pendulum wise, to the framework of the locomotive that the weight of the motor no longer makes the locomotive jump in passing the posts as it did until quite recently.

After several years of experimenting, we have in telpherage, I venture to think, at least a perfectly trustworthy, and, at the same time, a most economical method of utilising distant steam or water power to automatically transport our goods, and in time it may even be our people, over hills and valleys, without roads or bridges, and without interfering with the crops or the cattle, or the uses to which the land may be put, over which the telpher trains pursue their snakelike way; we have, in fact, the luxury of ballooning without its dangers.

CORRESPONDENCE.

The Editor does not hold himself responsible for opinions expressed by his correspondents, nor can he take notice of anonymous communications. All letters must be accompanied by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

EXTINCT BRITISH BUTTERFLIES.

Your interesting article on this subject (SCIENTIFIC NEWS, vol. ii., pp. 124 and 160) raises some questions to which I must beg to call attention. Our climate is admittedly less favourable to butterflies (and indeed to many other insects) than is that of Continental districts under similar latitudes. But such as it is, it has not, to our knowledge, undergone any changes within historical times. Now, if the lack of sunshine be a leading factor in the extirpation of, *e.g*, *Papilio podalirius* and *P. machaon*, how, it may be asked, did these species ever establish themselves in Britain at all?

Drainage must, of course, tell against the existence of species which feed upon fen vegetation. But this is certainly not the case with *P. podalirius* and *machaon*. The caterpillar of the former feeds upon sloes, plum, apple, and pear trees, and upon oaks. *Machaon* feeds upon the leaves of carrots, which are certainly more abundant than they were formerly. Further, on the Continent *machaon* is not a fen insect.

I must beg to express doubts concerning the following passage: "In our British climate thistles and kindred plants die early in the autumn, and before the larvæ can feed on them the chilly nights have withered the food plants." So far as I remember, the autumn frosts in northern and central France, Germany, etc., set in quite as early as with us, and the thistles will therefore be cut off quite as early.

The chief causes of the decrease or disappearance of the larger and more striking British butterflies are, I submit, the "British mania," to which you have referred from time to time, and the "ravages of the picture-makers," which you mention on p. 174. It is just possible that some of your readers may not know what is here meant by the expression "picture-makers." These people obtain by any means a quantity of butterflies, and arrange them in a glass case, not according to their structural affinities, but in concentric circles, in squares, triangles, crosses, or other patterns. The case is then hung up on the wall as a decoration. The extent to which this freak is indulged in is perfectly alarming. I have seen such cases form a prominent feature in exhibitions got up by country societies; and on one occasion, when stopping at Leeds, I saw an announcement that a collection of 50,000 beautiful insects was being exhibited in the Roundhay Park, and that the owner was willing to sell. On going there I found several rooms lined with these "pictures," in which more butterflies had been used up than a hundred genuine entomologists would have sacrificed in a life-time. To such follies, more than to climate, drainage and cultivation, I think that the decrease of our finer butterflies must be traced.

F. E. S.

THE MULTIPLICATION OF SPARROWS.

A correspondent in your issue of July 6th concludes, from certain observations which he has made, that "the sparrow is not so prolific as it is generally supposed to be." I should like to ask how does he, then, account for the fact that in most districts the sparrow is more common not only than any other bird, but often than all other species put together? I do not think that killing down, or even, were it possible, the extirpation of this marauder, would be injurious to the farmer and gardener, since scope would thus be given for the multiplication of the swallow and other true insectivorous birds which the sparrow persecutes and drives away.

As to the food of this bird, Mr. S. A. Forbes, writing in the *American Naturalist* for 1881, gives the following decisive evidence (p. 393): "I add a few notes on the food of twenty-five sparrows shot in and around Aurora, Ill., in the years 1879 and 1880. At a time when 30 per cent. of the food of the (American) robin, 20 per cent. of that of the cat-bird, and 90 per cent. of that of the blue-bird consisted of insects, no insects were found in the stomachs of the sparrows, except traces of three grasshoppers, making, perhaps, 6 per cent. of the food."

ARUSPEX.

FOOD OF THE LEECH.

Replying to "J. P. P.," in your issue of 5th inst.: In a small aquarium I had some time since, I found a young leech, inadvertently introduced, feasting on a small snail, which it was moving to and fro in the water, its other end being fastened to the glass, some distance from the bottom of the aquarium.

8th October, 1888. F. M.

RECENT INVENTIONS.

The following list has been compiled especially for the SCIENTIFIC NEWS *by Messrs.* W. P. THOMPSON *and* BOULT, *Patent Agents, 234, High Holborn, London, W.C; Newcastle Chambers, Angel Row, Nottingham; Ducie Buildings, Bank Street, Manchester; and 6, Lord Street, Liverpool.*

EXTINGUISHING FIRES.—Means for extinguishing fires in ships' holds and places in which furnaces are employed have been patented by Mr. H. C. Carver. This invention uses the waste gaseous products of combustion in furnaces for extinguishing fires. These products are conveyed through pipes and discharged on to the fires to be extinguished, thus rendering the atmosphere incapable of supporting combustion, and so extinguishing the fire.

VENTILATORS.—An exit ventilator has been patented by Mr. J. W. Gibbs. The object is to form the ventilators so that they have not the rattling noise noticeable in the ordinary mica-flap ventilators when variations of draught occur. This is attained by forming the surfaces which come in contact of a soft, non-inflammable material, which cushions the blow and obviates the noise. The material employed is asbestos, which works well simply fastened like an ordinary mica-flap.

MUSICAL INSTRUMENTS.—A mechanical musical instrument has been patented by Mr. J. M. Draper. It consists of a reed box containing a double set of reeds of different tone, each of which sets of reeds can, by means of opening and closing shutters covering the outlets of the reed box, be played at will, either alone or with other sets. By opening and closing the shutters the volume of sound is also controlled. Arrangements are made for providing this instrument with bells, cymbals, etc., which may be sounded at will.

DISINFECTING.—A disinfecting machine has been patented by Mr. T. P. Hollick. This invention dispenses with the means usually employed for disinfecting a house, such as sprinkling, or exposing the disinfectant in a basin, and is carried out by means of an endless cotton or flannel band, which passes round rollers arranged above a trough containing the disinfectant. The lower part of the bands rests in the disinfectant. As the top roller is revolved the band is moistened and raised, and exposed to the air in the room, thus disinfecting it.

TIDAL POWER.—A means of utilising the rise and fal of the tides for raising water for supplying baths, stree watering, etc., has been patented by Mr. W. Green. A reservoir is provided which fills at high water; a float i also provided, in an enclosure constantly open to th tidal water. On this float is mounted a hydraulic ram which communicates with the tidal reservoir by flexible pipe, as also with an elevated reservoir. As the tide falls it operates the ram by means of a valve, and continuously raises the water until the tide again rises.

ELECTRIC LAMPS.—An electric arc lamp has been patented by Mr. F. C. Phillips. The invention relates to the adjustment of arc lamps. On a spindle are rigidly mounted two wheels, to which are attached chains. To the free end of each of these chains is fixed an electrode. The chains are so arranged on the wheels that the electrodes suspended on the chains counterbalance each other, and by this arrangement the electrodes approach or recede from each other simultaneously, and at a relative speed, depending on the relative diameters of the two wheels to which the chains are attached.

MUSICAL INSTRUMENTS.—A tension-regulating device for the strings of musical instruments has been patented by Mr. W. Fischer. It consists essentially of an angular block for each string, pivoted upon its vertex in the framing of the instrument. The rear shank of this block is screwed down on to the framing, so as to move radially the other shank, which is provided with a pin, to which the string is secured. This pin consists of a screw, fastened in the block, by means of which tension is given to the string, being finally adjusted and tuned by the screw in the rear shank of the angle lever.

VARNISH.—An improvement in the manufacture of varnish, paint, etc., has been patented by Mr. A. G. Wass. The object is to utilise the waste products evolved in the refining and distillation of mineral oils and in the manufacture of gas. In the first case the waste product is an acid tar, and in the other case a tarry residue. These products are subjected, in a vessel, to a certain heat, and a proportion of rosin added. The products so treated are then thinned down with turpentine until the desired liquid state is attained, when it is allowed to cool, and the product can be used as a varnish, paint, enamel, etc.

CHAIRS.—A chair with an adjustable back and foot-rest has been patented by Mr. F. Vogel. The invention consists in the means by which the adjustment may be varied by the sitter without leaving the chair. The back is hinged at the rear of the seat, and the foot-rest to the front of the seat. These rests are connected by cords passing through the arms of the seat, in such a manner that by depressing the foot-rest the back is raised, and by depressing the back the foot is raised. At the passage of the cord through the arm is arranged a friction-brake, acting automatically, for securing the back and foot-rest in the position given to them.

ELECTRICAL MEASUREMENTS.—An apparatus for measuring electric currents has been patented by M. A. de Khomistry. The invention is based upon the unequal expansion of different metals, the essential part consisting in fixing together two or more strips of different metals to form a compound conductor, through which the current to be measured is then passed. This conductor thus becomes heated, and its unequal expansion will cause a curvature of same. If one end be fixed the other end will move according to the heat developed in the conductor. This motion is transmitted to a pointer on a graduated scale. The same method may be applied to making and breaking contacts and such-like purposes.

TECHNICAL EDUCATION NOTES.

SCHOOL OF ART WOOD-CARVING.—The School of Art Wood-carving, City and Guilds Institute, Exhibition Road, South Kensington, has been reopened, after the usual summer vacation, and we are requested to state that one or two of the free studentships in the evening classes, maintained by means of funds granted to the school by the institute, are vacant. To bring the benefits of the school within the reach of artisans, a remission of half-fees for the evening class is made to artisan students connected with the wood-carving trade.

THE GOLDSMITHS' COMPANY AND TECHNICAL EDUCATION.—The Goldsmiths' Company have made a proposal to the Charity Commissioners which, subject to the approval of Parliament, has been accepted by that body, whereby the buildings, with seven acres of land, at present occupied by the Royal Naval School at New Cross, will be acquired by the Commissioners out of the surplus funds of the City parochial charities. From the same source the Commissioners will set apart an endowment of £2,500 per annum, which will be met by the Goldsmiths' Company by the appropriation out of their corporate funds (not trust funds, but funds over which they have absolute control) of an annual endowment of a similar amount. The institute is intended to be called the Goldsmiths' Company's (New Cross) Institute. As soon as possible after the vacation a scheme will be prepared for the establishment of the institute upon the above basis, with provisions for the constitution of a governing body and for defining the work of the institute. This scheme will have to be laid before Parliament for approval, and the arrangement between the Charity Commissioners and the Goldsmiths' Company is necessarily made subject to that approval.

THE PEOPLE'S PALACE.—On October 5th the Master of the Worshipful Company of Drapers (Mr. J. H. Daniell) performed the ceremony of opening the new technical schools of the People's Palace for East London. These schools have been erected and will be equipped at the expense of the Drapers' Company, which has made a donation of £20,000 for that purpose. The class-rooms and workshops are not yet fully equipped, but in some cases work has been already begun, and before long the whole building will be utilized for the various purposes for which it has been erected. It embraces, among other apartments, engine rooms, electric and chemical laboratories, workshops for pattern-making and moulding, and for brickwork and masonry, an admirable lecture-room (which will be used on every week night), a mechanical drawing room, a building construction drawing room, a photographic studio, and a printing room. There will be two departments of education in this school—a day school in which the courses of instruction are arranged to extend over a period of two years, and an evening school in which classes will be held for apprentices, artisans, and foremen, in the scientific principles connected with the special industries in which they are employed, together with practice in the laboratories and instruction in the workshops. In the day school there will be courses of mathematics, mechanical and industrial drawing and science, with laboratory practice and the use of tools. Special efforts will be made to give those pupils who intend to follow the engineering, building, or other constructive trades, a thorough practical knowledge of drawing, construction, and mechanics, together with sufficient workshop instruction to enable the lads leaving school at the age of fifteen to understand and execute an ordinary working drawing. To those who are to be trained especially as engineers, the course of study will include drawing, the principles of pattern-making from drawings and to measurement, metal turning and lathe work, and construction of models from drawings of their own execution. The object of the school is to develop the faculties of the pupils by means of a systematic course of technical and manual training. It is not, however, intended to teach a trade, but simply to provide each pupil with an education which will fit him for making ready progress in any trade which he may subsequently be engaged in.

SALES.

The Charge for Advertisements in this Column is Sixpence for the first sixteen words, and Sixpence for every succeeding eight words. Advertisements for this Column should be received by first post on Tuesday to insure insertion in the following number.

Electrical Apparatus.—Special batteries for cautery, require no attention, plates remain in the liquid, no acids.

Electrical Apparatus : Special hand, foot, and power dynamos, for cautery, incandescent lighting, etc., wound with silk-covered wire.

Electrical Apparatus : Electromotors, dynamos, galvanometers, resistances, batteries, etc.—G. BOWRON, 97, Crawford Street, London, W.

Wanted.—Trap-Door Spiders and Nests; Larvæ and image of Ant Lion (Myrmelion); "stick" and "leaf" insects; for cash or exchange. State price or desiderata.—MARK SYKES, Adelphi Street, Salford.

Zuccato Typograph.—Cost 7 guineas; will take £3 10s., or offers.—Address, B., SCIENTIFIC NEWS, 138, Fleet Street.

Amateur Mechanics supplied with Lathes, Drilling, Planing Machines, Castings, etc. Cash, or easy payments.—Britannia Company, 100, Houndsditch, London.

Britannia Co. *Bona-fide* makers of 300 varieties of lathes, and other engineers' tools. Prize medals. Makers to the British Government.

Practical Hints on Electro-Plating, etc. One stamp.—Address HENRIC, 234, Great Colmore Street, Birmingham.

Amalgamating Brushes, Scratch-brushes, Polishing Sand, Calico Mops, Rouge and Crocus Compositions, Nickel Salts and Anodes.—HENRIC, 234, Great Colmore Street, Birmingham.

Do your own Electro Plating and Gilding. System inexpensive. Particulars one stamp.—PERKS, 47, Alexandra Road, Richmond, Surrey.

Watts' Gas Engines, all sizes, from 1½ bore, slide explodes charge, simple. Lists, 3 stamps.—Below.

Watts' Gas Engines, work without noise, are easily made up. Castings supplied. List, 3 stamps.—Below.

Dynamos for plating and lighting, experimental dynamos, electro motors, separate parts, wire, punchings, etc.—Below.

Dynamos, highest efficiency, castings or finished. List, 2 stamps.—WILLIAMS, WATT, AND Co., Belshaw Street, Homerton, E.

Mica or Talc cut for all purposes. Mica chimneys, Mica covers, etc.—C. JOHNSON, 87, New Oxford Street, W.C.

EXCHANGES.

Exchange Notices will be inserted in this Column at the rate of Sixpence for the first twenty-four words, and Threepence for every succeeding eight words.

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Powerful Electro-Motor, Grigson's pattern, on polished mahogany stand. Exchange for lantern slides, chromatropes, etc., to value 30s.—G. HARRIS, 17, York Street, Nottingham.

Student's Microscope, 2 achromatic powers, in mahogany cabinet, with 2 dozen best mounted slides. Exchange lantern slides to value £2.—G. HARRIS, as above.

SELECTED BOOKS.

The Principles of Agricultural Practice as an Instructional Subject. By J. Wrightson, M.R.A.C., F.C.S., etc., Professor of Agriculture in the Normal School of Science and Royal School of Mines, etc. With Geological Map. London: Chapman and Hall, Limited. Price 5s.

The Building of the British Islands. A Study in Geographical Evolution. By A. J. Jukes-Browne, F.G.S., of the Geological Society of England and Wales. London: Bell and Co. Price 7s. 6d.

Kirke's Handbook of Physiology. Twelfth edition. Thoroughly revised and edited by W. Morrant Baker, F.R.C.S., and Vincent Dormer Harris, M.D. London: J. Murray. Price 14s.

The Industrial Self-Instructor in the leading branches of Technical Science and Industrial Arts and Processes. With practical, useful, and technical notes, facts and figures for ready reference. Profusely illustrated by working drawings, designs, and diagrams. In five volumes. London: Ward, Lock and Co. Price 7s. 6d. each.

A Text-Book of Physiology. By Michael Foster, M.A., M.D., LL.D., F.R.S., Professor of Physiology in the University of Cambridge, etc. With illustrations. Fifth and thoroughly revised edition. In three parts. Part I. comprising Book I., Blood—The Tissues of Movement—The Vascular Mechanism. London: Macmillan and Co. Price 10s. 6d.

DIARY FOR NEXT WEEK.

Saturday, Oct. 13.—Chesterfield and Midland Counties Institution of Engineers, at 2·45 p.m.—*The Dumb Fault;* Mr. G. Elmsley Coke. *Stanley's Coal Heading Machine;* Mr. R. Stanley. *Past and Present Methods of Banking Coal at Annesley;* Mr. J. Timms. *A Double-Acting Wedge for Getting Coal;* Mr. [illegible] C. Cox.

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METEOROLOGICAL RETURNS

for the ten weeks ending on Monday, Oct. 1st, 1888. Specially prepared for SCIENTIFIC NEWS from official reports.

	Mean Temperature.	Rainfall.	Duration of Sunshine.
Scotland, East	52·5 degs., being 2·5 degs. below average.	4·0 ins., being 2·4 ins. below average.	297 hrs., being 24 hrs. below average
England, N.E.	54·0 " " 2·5 " " "	5·8 " " 0·5 " " "	251 " " 42 " " "
England, East	57·0 " " 2·7 " " "	6·3 " " 0·4 " above "	327 " " 31 " " "
Midlands ...	55·3 " " 3·2 " " "	5·1 " " 1·6 " below "	312 " " 22 " " "
England, South	57·8 " " 1·8 " " "	5·6 " " 0·4 " " "	351 " " 19 " " "
Scotland, West	53·5 " " 1·9 " " "	6·9 " " 3·6 " " "	301 " " 22 " " "
England, N.W.	54·9 " " 3·0 " " "	6·9 " " 1·2 " " "	315 " " 12 " " "
England, S.W.	56·0 " " 2·5 " " "	7·2 " " 2·2 " " "	371 " " 40 " " "
Ireland, North	55·1 " " 2·5 " " "	7·7 " " 0·2 " " "	261 " " 13 " " "
Ireland, South	55·6 " " 2·1 " " "	6·3 " " 1·8 " " "	345 " " 10 " above "
The Kingdom...	55·2 " " 2·5 " " "	6·2 " " 1·4 " " "	313 " " 22 " below "

Scientific News

FOR GENERAL READERS.

Vol. II. OCTOBER 19, 1888. No. 16.

CONTENTS.

SCIENTIFIC TABLE TALK.

By W. Mattieu Williams, F.R.A.S., F.C.S.

On page 262 of Scientific News is an abstract of a note read at the British Association by the Rev. A. Irving, D.Sc., on the "Relation of the Percentage of Carbonic Acid in the Atmosphere to the Life and Growth of Plants." According to experiments there referred to, the vigour of plant life is increased by increasing the supply of carbonic acid in the air up to about an equality of the oxygen, *i.e.*, to about 600 times as much as the air at present contains, provided the roots are freely supplied with water.

This is a rather startling result, and so much opposed to those of other experiments, that I am not surprised to read on page 288 that Professor Seeley expressed some scepticism, and referred to the fact that the surroundings of lime kilns are not remarkable for luxuriant vegetation. To this example I may add that of the celebrated Grotta del Cane, from which there is a continual overflow of carbonic acid pouring down the slope of the valley towards the lake below. This is shown by immersing a torch in the pool of carbonic acid. The torch is thereby extinguished, but its smoke adheres to the heavy gas and accompanies its overflow, thus rendering its course plainly visible if the experiment be so performed as to produce a good supply of smoke. There is another similar outflow of carbonic acid shown in the same valley, which, when I was there, bore the name of "the fountain of natural beer," a name based on the experiment of standing knee-deep in the gas and scooping draughts to the mouth by the hand, thereby obtaining a taste similar to that of the effervescing beverage known as "birra" to the Neapolitans. The carbonic acid overflows abundantly from this and other places in the neighbourhood. If Dr. Irving is right, the course of all these streams should be indicated by specially luxuriant vegetation, but such is not the case.

Another subject was opened by this paper, viz., the assumed or supposed excess of carbonic acid in the carboniferous age. This supposition includes another, which in spite of its wide and free acceptance, appears to me to be a very superficial one. I refer to the matter-of-course assumption that at the time when our particular coal seams were in the course of deposition, all the rest of the world was engaged in just the same kind of geological business.

We know that in certain areas certain deposits were formed later than those upon which they rest, and earlier than those above them; but we have no evidence to prove that similarity of composition of any particular deposit, or even similarity of fossils, proved simultaneous deposition *all over the world*.

We do know, for example, that the fauna and flora of Australia and New Zealand actually living there prior to the interference of British colonisation, differed more widely from the simultaneously existent fauna and flora of Europe, Asia, and Africa, than do those revealed by the fossils of the post-pliocene and pliocene, and even earlier periods, and that they were more nearly allied to these than to living species on our side of the world.

At the present time the lithological character of current deposits varies with the rocks from which the depositing rivers obtain their material, or those of the shores which the sea waves are wearing down. Besides these variations we have glacial deposits and volcanic rocks simultaneously in the course of formation, and we have great peat bogs growing and ready for submersion in some places but none in others.

As I have shown (see "The Formation of Coal" in "Science in Short Chapters"), we have coal seams now in course of formation in the Aachensee and the fjords of Norway, that have come under my own observation, and doubtless in a multitude of other places where similar conditions prevail.

In the interesting account of the inhabitants of the Canary Islands, by Mr. J. H. Stone (Scientific News, page 355), we have an example of the so-called "stone age" ("*stone stage*" would be better) flourishing in modern times. The same occurs in New Guinea.

The deep sea explorations of the *Challenger* and other expeditions have inflicted serious thrusts on the established practice of determining geological *time* periods by fossil fauna, living creatures having been fished up from the deep sea which, had they been found as fossils, would have been referred to palæozoic periods rather than to recent life. But these thrusts are mere skin wounds compared to what is likely to follow, when we consider how very narrow is the scratch on the ocean bottom that has yet been made by the dredge compared with the enormous area that remains unexplored.

We are evidently moving in the direction of a general inference that physical conditions, not chronological eras, determine the course of geological evolution, both as regards the physical constitution of rocks and the fossils they contain. At the recent International Geological Congress, Dr. Sterry Hunt stated his belief that the action by which the old granites as well as the basic gneisses were formed "had continued since the most remote period, and was going on at the present day with diminished intensity" (see report, SCIENTIFIC NEWS, page 347); and Dr. Hicks, who followed, though differing with Dr. Hunt on the Wernerian and Plutonic controversy, "admitted that rocks of volcanic origin could change at any period of the world's history into crystalline schists under favourable conditions." It would be difficult to find two higher authorities on this particular part of the subject than these.

Many who are not experts in geology have been, and still are, deceived by the manner in which the term "carboniferous group" or "strata" is used in geological treatises. They imagine that coal is only found in the "carboniferous strata." As a matter of fact, all the strata of all ages, from the lowest of the palæozoic to the recent, are more or less carboniferous. The strata which have received the distinctive title of "carboniferous" are simply those which in the British Isles and some other places are specially rich in one particular kind of coal. This kind of coal and other kinds of coal abound in other countries both above and below *our* coal measures, and even in our country good workable coal is found below this and below the millstone grit (or "farewell rock," as our *local* miners call it, from their experience of the hopelessness of finding coal when it is reached). Coal is found and worked in the mountain limestone and limestone shales of Durham, Northumberland, and Scotland.

Returning to the idea of an era of carbonic acid excess in our atmosphere, it should be remembered that even in our "carboniferous group" there is no indication of a *general* excess of vegetable growth at that period; the coal seams are partial deposits found here and there in lake basins or long estuary troughs.

Besides this we must remember that if at that period the whole world were immersed in an atmosphere containing any great excess of carbonic acid beyond that now prevailing, all terrestrial animal life would have been destroyed, the chain of evolution broken asunder in such a manner that the course of creation of land animals and birds, if not of the marine vertebrata also, would have to start afresh. This is directly contradicted by the geological record.

SOME PHOTO-MICROGRAPHIC APPARATUS.

(Continued from p. 379.)

ANOTHER form of apparatus made by Messrs. Swift is shown in the woodcut, fig. 4. In this case the whole apparatus is mounted on a table, which is supported on three legs, which, to add to the portability of the instrument, are made to unscrew.

The microscope supplied with the apparatus has rackwork motion to the internal draw-tube for use in the adjustment of an amplifier, when such is required. A stop is placed across the claw-foot of the microscope, to ensure the tube being brought correctly to the horizontal position.

A slot traverses nearly the whole length of the top of the table, along which the illuminator apparatus, the board upon which the microscope is fixed, and the camera are made to slide.

The camera is constructed to take plates up to $6\frac{1}{2}$ in. by $4\frac{3}{4}$ in., and has a range of from 6 in. to 30 in., and a double rack-work arrangement for effecting this extension.

Focussing with the fine adjustment can be done from the back of the camera by means of a rod carried along the side of the table, at the end of which is a pulley, over which a fine cord passes to the milled head of the fine adjustment.

Specially corrected objectives are supplied for use with this instrument, by the aid of which the object to be photographed can be definitely focussed upon the screen, since the actinic and visual foci are identical.

With this apparatus excellent work can be done.

Fig. 5 shows a very perfect apparatus designed by Dr. Crookshank, and made for him by the last-named firm. The instrument was specially designed for use with very high power objectives, for the photography of Bacilli. How excellent are the results obtained, can best be judged by reference to Dr. Crookshank's work, "Photography of Bacillus," the photo-lithographic illustrations in which were produced from negatives procured by means of this instrument.

Owing to the small amount of light passing through the lenses of high power objectives, illumination by means of paraffin would necessitate very long exposures; the oxy-hydrogen limelight is therefore used as the illuminant, a special series of lenses for condensing the light on to the object being arranged in front of the lantern. The heat arising from the condensation of a powerful light on the object under examination would probably injure it by melting the medium in which it is mounted; to obviate this, a glass trough containing a strong solution of alum is inserted between the condensing lenses, the action of the alum being to absorb most of the heat rays in the illuminating pencil.

Fig. 5 shows the apparatus in the position in which it is most generally used, but in case it is desired to photograph liquids, the apparatus can be brought to the vertical position. This is done by removing the two bars which act as ties between the legs which support the instrument, folding the leg at the lantern end of the table beneath the board, and traversing up the back legs by means of the screw provided for the purpose. A slab is provided, which, together with these legs, supports the instrument very securely.

A few words descriptive of the arrangement of the apparatus may be found of interest. The oxy-hydrogen lantern and the microscope are mounted on a table which rotates on metal centres, thus enabling the microscope to be turned to one side for centering, etc. The lantern can be moved to or from the sub-stage, as may be found necessary for the adjustment of the illumination. The camera is very similar to that before described in Swift's apparatus, having a range of 30 in.

The fine adjustment is done from the back of the camera by means of the usual rod carried along the table, but the arrangement differs considerably from any before described.

The fine adjustment to the microscope is connected by means of a fine cord to a small pulley keyed to a pinion, carried on a bracket secured to the revolving table, upon which the lantern and microscope are fixed. At the end of this pinion is a grooved pulley, which, on the microscope, etc., being brought into the central position in front of the camera, gears with a small rubber-tyred pulley, fixed at the end of the rod which extends to the back of the camera.

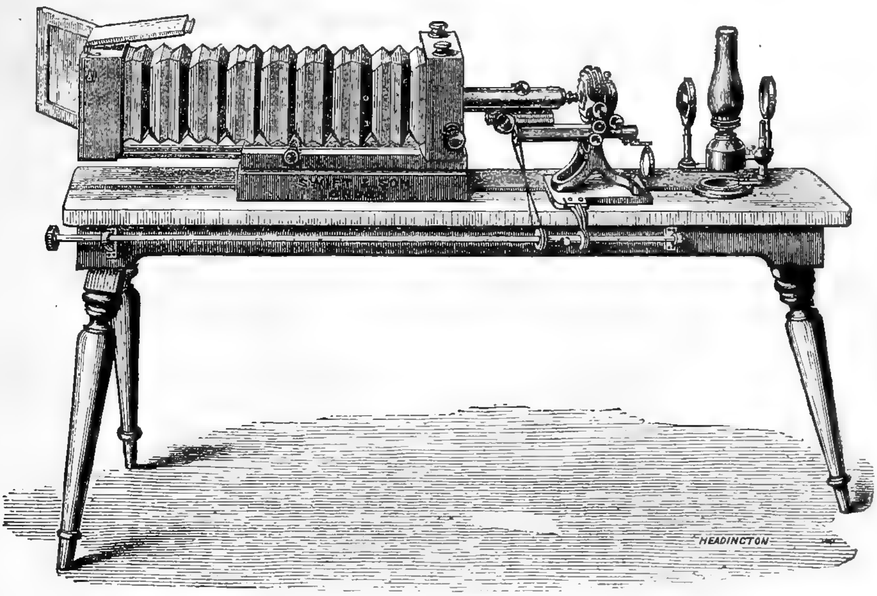


FIG. 4.

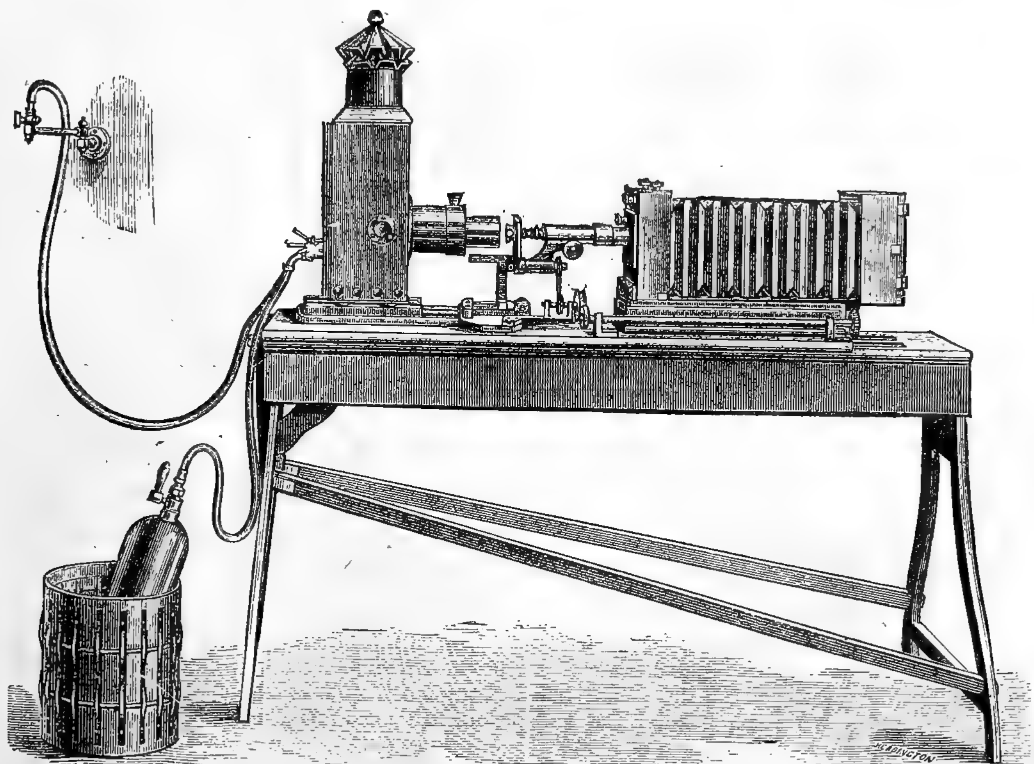


FIG. 5.

This method will allow the lantern and microscope to be turned to one side without disconnecting the cord, a matter sometimes forgotten when the fine adjustment screw is worked direct from the pulley on the rod, to the great detriment of a delicately constructed instrument.

THE ANCIENT INHABITANTS OF THE CANARY ISLANDS.

A Paper read by Mr. J. Harris Stone, M.A., before the Anthropological Section of the British Association.

(Continued from page 381.)

IN Gran Canaria I saw a number of what, for want of a better name, may be called seals, some of which are shown in fig. 4. Their purpose is unknown. They are made of baked pottery and deeply marked in various patterns. Some are circular, others square and triangular, varying in size from one inch to four. Perhaps a more realistic description of them would be to say that they are like small butterprints, as used at the present day. Somewhat similar articles are found in Egypt, whose use, like these Guanche things, is also unknown.

The natives were moderately expert in making and baking vessels of pottery which were of simple, but what would now be termed artistic shapes, and marked, like those in figs. 5 and 6, with various patterns.

Some few stones with what are said to be inscriptions have been found, but none yet have been deciphered. It is thought that some of the characters are Phœnician. One of these stones is said to be bilingual, being graven in the same character as the Tougga stone, with a translation in Punic letters, which would make the date not later than the second century B.C.

Their staple food was *gofio*, roasted grains ground to powder, and eaten mixed with water. Several *gofio* hand-mills have been found, both rotatory, and those with a simple backward and forward movement, a round stone being rolled in a narrow trench cut in another oblong stone. They obtained fire by the friction of wood, and I saw in Gran Canaria a piece of wood about eight or nine inches in length scooped out by friction, and a pointed stick which was found by it.

They shaved with sharp stones, and according to Galindo, when they were troubled with acute pains they drew blood from the part affected with lancets made of tabonas or sharp stones.

The natives were great wrestlers, and exhibitions of wrestling, and fighting duels seem to have been of frequent occurrence. These spectacles were considered to make a great impression on the minds of the youth, exciting them to healthy emulation and gallant deeds. A famous wrestler called Adargoma, was captured and taken to Spain, where a celebrated wrestler of that country challenged him to a trial of skill. Adargoma accepted the Spaniard's challenge, and said to him, "Brother, since we are to wrestle, we had better first have a drink together," then taking a glass of wine in his hand, he said to the Spaniard, "If you can, with both your hands, prevent my carrying this glass of wine to my mouth, and drinking it, or cause me to spill one drop of it, then we will wrestle together, but if you cannot do this, I would advise you to return home." Then drinking off the wine in spite of the other's utmost efforts to prevent him, the Spaniard, amazed at the Canarian's prodigious strength, prudently took his advice and sneaked off.

Their religion had more of a spiritual than material character. They had no idols.

In Palma the natives held the sun and moon in great veneration; keeping an exact account of time in order to know when it would be new or full moon, and for recording their days of devotion. They seem to have worshipped one God in the heavens who was greater than all.

In Tenerife the natives adored one God, whom they worshipped by the names Achguarergenan, Achoran, and Achaman, which signify the Sustainer of the Heavens and the Earth. He was also called by other names, the Great, the Sublime, and the Sustainer of all.

A favourite method of disposing of the dead was to lay them on the rough volcanic ground near the sea, and cover them with pieces of lava. Two of these cemeteries I have explored in Gran Canaria. There possibly may be more than these two ancient burying-places, and if so, it is to be hoped that other travellers will pay particular attention to them. Those I have examined are at Agaete and on the Isleta. Figure 7 is from a photograph of the Isleta cemetery looking towards Confital Bay. These cemeteries agree exactly in situation and character of the ground. The *antiguos Canarios* must have liked to be buried close to the sea. The choice of this unpromising-looking ground, composed entirely of the roughest of rough stones found in a volcanic country, without a particle of mould, might perhaps be due to the singularity of the spot, to the great difference existing between it and the neighbouring country. These outbursts of past volcanic fury not unlikely assumed religious importance in their eyes. It may of course be urged that, owing to the value of pasture land, such would not have been used for burial purposes, or that, the ancient inhabitants possessing no digging tools, this lava-block-covered land afforded the easiest mode of burial for the mass of the population. The first theory for the origin of these singularly placed cemeteries is that which I think most accords with what we know of the race. There is one difference I should note between the cemetery at Agaete and that on the Isleta. The covering mounds of stone at Agaete over the largest graves contain red stones. I noticed none on the Isleta graves. It would be interesting to know who were the persons dignified by having red stones in their burial piles, and why in regard to this custom the *Canarios* of the north differ from those of the west.

The mounds are of various sizes and shapes, the only uniformity being that the sides, for a height of about 4 feet, are wall-like, composed of large cinder stones, whose more or less flat surfaces are carefully ranged upon the exterior. The top is formed by smaller stones thrown on and allowed to settle in any order, but naturally assuming more or less of a flattish pyramidal shape.

On the Isleta two partially dismantled graves were measured. One was chosen for its unimportant appearance, and the other because it was one of the, if not the, largest on the ground. The former was 15 inches wide and just 1 foot below the level of the ground, the topping stones which covered in the body resting their ends on the ground on either side. Its length was 6 feet 6 inches, and it was rudely squared at the ends. The other grave had been covered by a large, circular mound, and lay due north and south. The stones had been pulled down at the north end exposing the grave, from which the skull had been taken, though there remained the ribs, vertebræ, femurs, and a few small bones, all of which, from their great size and very marked eminences for the attachment of muscles, showed that the man had been tall, well-built, and very powerful.

The inside of the grave formed a chamber, lined with immense pieces of flat lava stones, and roofed with others of a concave shape. The grave was therefore dome-shaped, but 7 feet long, and rounded off at the ends, not squared, as in the smaller grave. The height

Fig. 4.—Seals.

fflth more at floor to the highest point of the roof was 3 feet 9 inches, and in width the grave was 22 inches.

I noticed the direction in which the bodies had been laid in the ground, and had expected to find that the old Canarios buried east and west; but such was not the case, for the first narrow trench ran due north and south. The next lay north-east and south-west, and of the fifty or sixty graves which were examined, more lay north and south than in any other direction. It must have been from mere cursory examination or mere hear-say evidence that Gaptain Glas, in 1764, asserted that the Canarios buried their dead with their heads towards the north, and that later Messrs. Berthelot and Webb said that they buried east and west. Together, these assertions are correct; singly, undoubtedly they are incorrect. If they intended to bury in any particular direction, they were most careless in the way they did it. The inspection of the cemeteries of Agaete and the Isleta, the disposition of the mounds, and a close examination of the open graves, forced the conviction upon me that no particular direction was followed. At the Isleta cemetery, where there must have been several hundred mounds, the marked difference in the size of the lava piles was most noticeable. The largest were quite six times as big as the smallest. Some of the large ones, instead of following the usual oblong shape, were circular.

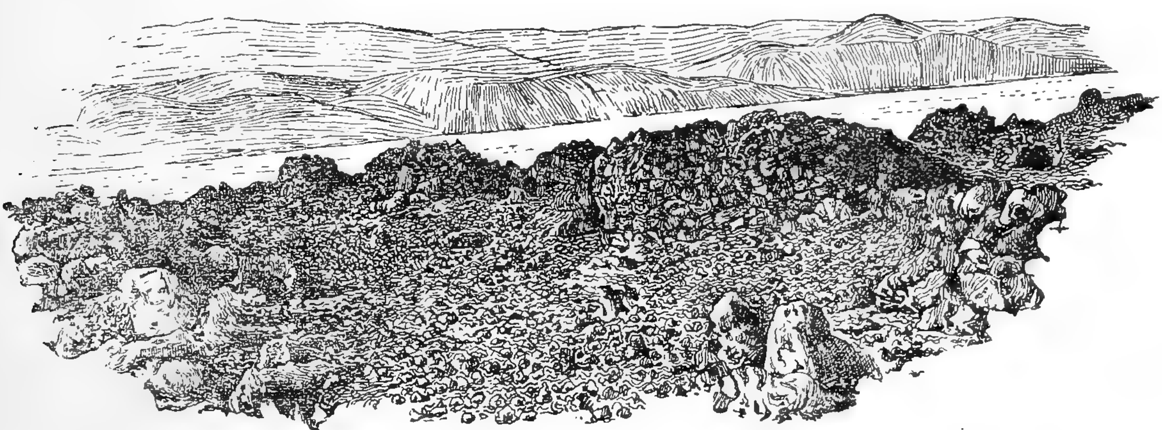


Fig. 7.—Guanche Cemetery.

Position of their Women.

A significant sign of the character of a people is

Fig. 5.—Guanche Pottery.

always the social and political position of its women. Whether they are used merely as beasts of burden, as valueless appendages to the men, or as worthy of consideration in the nation's deliberations and councils, whether, in short, they are looked down upon or looked

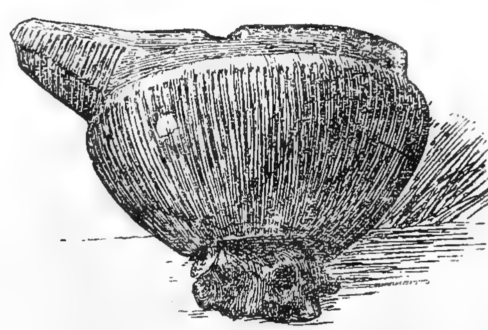


Fig. 6.—Guanche Pot.

up to and honoured, are questions well worth attention when investigating the character of a nation, whatever may be the race, whatever the time in which it lived. The position of women among the ancient inhabitants of the Canary Islands was unusual when compared with other old races. The matter has not been before, so far as I am aware, ever separately considered. It must be confessed that the actual facts we have to go upon are scanty, but by dint of careful reading between the lines of the narratives which have come down to us, a fair estimate of the position of women is obtainable. For this purpose our main reliable sources of information may be reduced to two, although we obtain a few hints from the remarks of casual travellers, the MS. of the two priests who chronicled Bethencourt's conquest, and the Spanish MS. of Father Juan de Abreu de Galindo (or Galineo according to Glas) a Franciscan Friar. I have already alluded to the former. The latter MS. was translated and published by George Glas as far back as 1764, but was only published in Santa Cruz de Tenerife as late as 1848. Galindo wrote the narrative in the year 1632, some 130 odd years after the conquest, in the island of Palma, the island, be it remembered, which was sharply and quickly conquered in about six months without any serious depopulation. There the customs and habits of the old inhabitants would be still readily traceable and more prominent than if studied in an island which had been slowly decimated, and therefore almost solely by the uncertain light of tradition. Even to this day the conservatism of Palma is most noticeable, more custume for example, being preserved there than in any of the other islands.

Unlike s[illegible]vage nations, the women do not seem to have [illegible]rtake tasks of laborious toil. In Tenerife the [illegible]pared the ground for seed by hoeing it with wooden hoes, and then the women did the lighter task of scattering the seed in the hollows. The women helped, as they still do in most civilised countries, in gathering in the harvest and in winnowing the ears. When the men, women, and children waded into the sea to drive a shoal of fish towards the shore, we are particularly told that an equal division of the prize was made, every woman receiving a share and one for her children. In the incidents and occupations of domestic life the women doubtless played their usual part. We are told nothing to the contrary, and therefore may fairly presume that if the conquerors and travellers had noticed anything unusual in this respect they would have recorded it. We are told that in Canaria the women did the painting and dyeing, and in the proper season gathered the flowers, shrubs, etc., from which they extracted the several colours. In battle they waited on the men, succoured the wounded, and removed the dead.

They were treated with respect. In Tenerife they had a custom that when a man by chance met a woman alone on the road or in a solitary place, he was not to look at or speak to her, unless she first spoke to or demanded ought of him, but to turn out of the way; and if he made use of any indecent expression or behaved in an unbecoming manner he was severely punished. Even in their wars among themselves it was held to be base and mean to molest or injure the women or children of the enemy, "for they considered them as meek and helpless, therefore improper objects of their resentment." Though this relates specially to Canaria, from what we know generally of the other islands, the same noble sentiments may fairly be attributed to their natives also. The men were careful to protect their women from the enemy. When the Spaniards once unexpectedly came upon a body of some fifty natives near a wild pass in the centre of Fuerteventura, they at once rushed to attack the invaders of their islands, in order to hold them in check till their wives and children were in safety. For rudely armed people to thus take the initiative against an enemy armed with weapons of iron and clad in mail shows a great amount of courage.

The women, too, were not deficient in bravery. Rather than fall into the dreaded hands of the licentious conquerors, we read of two women throwing themselves down a precipice in Canaria. Another woman strangled a child at her breast for fear that its cries might inform the enemy of the presence of her companions. When driven to bay, the women could fight, and did fight well.

The heroic king Benhearo, who with Benchomo made the name of Guanche renowned and celebrated in Europe, was accompanied by his daughter Guacina, who, it is said, rode at the head of the troops.

The diplomatic capability of the ancient Canario women of high rank is well illustrated in the following story: "Before the advent of Bethencourt there lived in Galdar a young and beautiful woman, of noble birth, who was as wise and good as she was beautiful. At that time Canaria was governed by many nobles in different districts of the island, who met together and formed a council for general matters. They had much trouble in keeping peace, and Andamana, by her sage advice to the people, aided them much. The nobles or chieftains were, however, jealous of her influence, and not liking a woman's interference, they persecuted her and her followers in Galgar, and persuaded the people not to listen to her. This hurt her much, as she had given the best part of her life to them. She did not rest satisfied with complaints, but took to action. Going to Guimidafe, one of the chieftains who was considered the 'most valiant and prudent of all the nobles in Canaria,' and who lived in a cave, she told him her grievances, and proposed an alliance with him. It is not the only occasion in the world's history that the women of royal blood have been obliged to be suitors. Guimidafe seems to have consented readily to espouse the princess and her cause. Accounts differing slightly render it uncertain whether she fought and conquered the island before marrying Guimidafe or whether they married first and fought—their enemies—afterwards. The latter is the more probable. At any rate, Andamana and Guimidafe reigned over a united Canaria. They had one son, Artemi, famous for his courage and virtue, who became king, and it was during his reign that Bethencourt landed at Arguineguin, where he was repulsed with loss."

This cave of the beautiful Andamana at Galdar is the one that we had cleared out of its rubbish, and where were found the paintings which have been already alluded to

(To be continued.)

A Plague of Aphides.—During the fine weather of September, there occurred in certain Midland districts a perfect plague of *Aphides*, lasting for about a week. So numerous were they, that persons walking or riding found their mouths, noses and eyes constantly filled with these troublesome insects. This fact is the more remarkable since during the spring and summer *Aphides* were exceptionally scarce, as were also their principal enemies.

General Notes.

Pollax Island.—According to advices received at New York from Yucatan, this island, on the coast of that Republic, disappeared during the recent cyclone in that region.

The Propagation of Cholera.—Dr. Otto Riedel, in a recent work, admits that insects—he should have stated more precisely two-winged insects (*Diptera*)—constitute an important agency in the distribution of the cholera-bacillus.

The Chlorides of Iridium.—M M. Nilson and Petterson have communicated to the *Comptes Rendus* an account of three well-defined chlorides of iridium. They remark that a metal of the third group of the natural system of the elements is thus found capable of acting either as a univalent, divalent, or trivalent body in definite compounds.

Frozen Milk.—According to *La Nature*, M. Guerin, of Grandvilliers, has devised a practical method of freezing milk, so that it may be kept for weeks unchanged, and transported to any distance in the solid state. It may then be re-converted into a liquid by a simple rise of temperature, and is fit for consumption, not having lost any of its natural properties.

The Fertilising Effects of the Nile.—Prof. A. Müntz recently undertook to show that the perennial fertility of Egypt was due not so much to the mud deposited by the Nile as to the properties of the water. But on analysis he found that the water of the Nile was poorer in nitrate of potash than that of the Seine. The Nile conveys only 3 to 7 milligrammes per litre of nitrate of potash, whilst the Seine contains 11.

Formation of Hair-Silver.—Opificius (*Chemiker Zeitung*) shows that on igniting powdered sulphuret of silver in a current of hydrogen, the silver is obtained in the form of fine hairs, which shoot up out of the mass, forming a dense thicket of fine threads of metallic silver. Sulphuret of silver yields the same product in a current of carbonic acid. Copper may also be obtained in the form of hairs or threads on heating the sulphuret of copper in a current of hydrogen.

A Lunar Rainbow.—M. de Valois, Mayor of Aumâtre, writes in *La Nature*, that on Monday, September 24th, he observed at Aumâtre, about 9.45 p.m., during stormy weather, and whilst a slight rain was beginning to fall, a well-marked lunar rainbow, having the appearance of a very luminous halo on a dark ground, and which extended in the form of the arc of a circle over about 100 to 110 degs. It rose at first almost vertically in the north-west and terminated at the west near its highest point.

Chemical Reactions between Solids.—A Belgian chemist, M. W. Spring, finds that certain solid bodies, if submitted to intense pressure, can act upon each other and enter into combination. Thus, when a mixture of sulphate of baryta and carbonate of soda was exposed to a pressure of 6,000 atmospheres 11 per cent. of the sulphate was transformed into carbonate. Hence the old adage of the chemists, "Substances act upon each other only when in solution" (*Corpora non agunt nisi soluta*), no longer expresses an exact truth.

Effects of Petroleum upon Health.—M. Wiecyk has studied the effects of petroleum vapours upon the workmen in the Carpathian oil region. These men have to breathe an atmosphere tainted with hydrocarbons, ethylene, carbonic acid, carbonic oxide, and sulphuretted hydrogen. Cases of asphyxia are not rare. The affections ordinarily incident to long-continued work are tinglings in the ears, dazzling, throbbing of the arteries in the head, syncopes and hallucination, palpitations and general weakness. Consumption and epidemics are rare.

Glacier Dust.—The holes with which the great interior glacier of Greenland is studded (*Le Siècle*) were found by Prof. Nordenskiöld and his companions to contain each a quantity of mineral dust, to which their origin, on well-known physical principles, is supposed to be due. As to this dust, the question arises whether it has come from the realms of space, or whether it has been projected from volcanoes. The similarity of the composition of this dust with that of meteorites causes the majority of eminent authorities to incline to the former opinion.

Profits of Timber Growing.—Mr. G. Cadell (Macmillan) shows that the revenue of the Government forests in India in 1886-87 showed a profit of 41,017,000 rupees. This has been built up "from not only an entire absence of income but from a rapidly decreasing capital." The means used have been simply "restraining the destruction of the forests by the wood merchants, guiding, without checking, the cutting of trees by the peasantry for their farming and building necessities," and taking a middle course between reckless waste and oppressive restriction.

The Speed of Light.—The following figures, quoted by *La Nature* from the results of independent observers, show that there exists comparatively little disagreement on this important point. The velocity, in kilometres per second, is given by

Foucault, in 1862	298,000
Cornu, 1874	298,500
Cornu, 1878	300,400
Cornu, according to Listing	299,920
Young and Forbes, 1881	301,382
Newcomb, 1882	299,860

Influence of Aluminium upon Cast-Iron.—Messrs. Keep, Mabey, and Vorce give an account, in the *Journal of the Franklin Institute*, of the value of small proportions of aluminium as an addition to cast-iron. It appears from their experiments that fused wrought-iron, a mixture of cast-iron and steel, or steel alone, either of which would yield castings full of blow-holes, will make solid and homogeneous castings if as small a quantity of aluminium as $\frac{1}{10}$th of a per cent. be added just before pouring. Great benefit is promised to the iron-founder from the rapidly falling price of aluminium.

Influence of Drinks upon Digestion.—Dr. A. Heneynoki, assistant at the Rostock Medical Klinik, has recently, according to the *Naturwissenschaftliche Wochenschrift*, made experiments on this question. Water in quantities up to 22 to 23 fluid ounces has no appreciable effect

Alcohol diluted down to 4 per cent., and in quantities of about 8 fluid ozs., if it does not assist digestion certainly does not impede it. At the strength of 10 per cent. it has a perceptible, and at 20 per cent. a very decided, impeding action. Beer, up to about 26 fluid ozs., has the same action as highly diluted alcohol. Red wine, up to 17 fluid ozs. ($\frac{1}{2}$ litre), has the same action as beer. White wine assists digestion. The most favourable action is that of coffee and tea.

Fluorine and Vegetation. — Among the principles found in the ash of many vegetables, especially cereals, fluorine has not yet attracted the attention of agriculturists. What part does it play? Is it necessary to examine if it could be usefully added to the soil like the phosphatic and potassic manures? These are questions which, says *La Nature*, we cannot answer. It is, therefore, with much interest that we have read a pamphlet on calcium fluoride and its use as a manure, published by M. Dussan, a farmer in the *Basses Pyrénées*. M. Dussan informs us that in experiments carried on for three years upon wheat, maize, potatoes, clover, and lucern, calcium fluoride, along with phosphates and salts of potash, confer a remarkable energy upon vegetation. We may here remark that many of the phosphatic minerals employed in the manufacture of superphosphates contain an appreciable quantity of fluorine, all of which is scarcely expelled in the process.

A Dearth of Frogs.—It happens this year that frogs are scarce. Perhaps the sharp night-frost of October 2nd has driven them earlier than usual to bury themselves for the winter. No general lament is to be expected for the reduced numbers of a rather unpopular creature, but the directors of our now numerous physiological and biological laboratories are much bothered to get a sufficient supply of the "martyr of science." This leads us to ask why the dealers do not adopt a simple precaution which would enable them to collect frogs at any season, and keep them till wanted. Frogs become torpid at a moderately low temperature, and by sinking them to the depth at which the earth possesses an invariable degree of warmth, they may be kept almost indefinitely without consciousness or wasting. A pit about 4 ft. deep, covered by a stout wooden lid at the surface, and another near the bottom, answers very well. The frogs should be placed twenty or so together in boxes lined with dead leaves. Anyone who tries this plan may count upon a supply whatever the state of the weather.

Literary Announcements.—An important new work, entitled "Practical Surveying," by George W. Usill, A M.I.C.E., will shortly be issued by Messrs. Crosby Lockwood and Son, London. It will form a text-book for students preparing for examinations or the colonies. The same publishers also announce for immediate publication—"Antiseptics: a Handbook for Nurses," by Annie M. Hewer, diplomée of the Obstetrical Society of London; "The Mechanical Engineer's Office Book," by Nelson Foley, second edition, much enlarged; "Turning," a text-book on the elementary principles and practice of using the lathe, with numerous engravings and diagrams, by P. N. Hasluck; "The Model Engineer's Handybook," by P. N. Hasluck; "The Clock Jobber's Handybook," by P. N. Hasluck; "The Cabinet Worker's Handybook," by P. N. Hasluck; and also the following works in their popular "Weale's Rudimentary Series":—"The Art of Practical Brick Cutting and Setting," by Adam Hammond, author of "Practical Bricklaying," with ninety engravings; "Plumbing: a Text-Book to the Practice of the Art or Craft of the Plumber," by William Paton Buchan, fifth edition; "Modern Workshop Practice," by J. G. Winton.

A Mysterious Illumination.—The White Star steamer *Britannic*, which arrived at Queenstown on October 11th, *en route* for New York, reports that at 9.30 on Wednesday night, when off South Arklow, a most singular phenomenon was observed in the heavens by the captain, officers, and passengers who were on deck at the time. The sky to the westward, which was perfectly dark, no stars being visible, became suddenly illuminated with a brilliant light of a pale yellowish hue, which lasted for fully fifteen minutes, gradually changing into a fiery red colour, which appeared to be the reflection of a large ship in flames. The captain and officers, who had never witnessed such a strange sight before, and not knowing but that they were in the vicinity of a burning vessel, altered the course of the *Britannic* somewhat, so as to bring her more in the direction of the place from which the glare seemed to arise. In a few minutes the fiery red colour became divided into two sections, which appeared disturbed by flutterings, and gradually diminished into a small clear white light resembling that of a steamer's masthead light, which faded into darkness, and the entire illumination disappeared.

The Public Health.—The Registrar-General's return for the week ending October 6th, shows that the deaths registered during that period in 28 great towns of England and Wales corresponded to an annual rate of 18·2 per 1,000 of their aggregate population, which is estimated at 9,398,273 persons in the middle of this year. The six healthiest places were Oldham, Nottingham, Wolverhampton, Bristol, Huddersfield, and Birmingham. In London 2,413 births and 1,352 deaths were registered. Allowance made for increase of population, the births were 300 and the deaths 106 below the average numbers in the corresponding weeks of the last ten years. The annual death-rate per 1,000 from all causes, which had been 15·8 and 16·0 in the two preceding weeks, further rose last week to 16·5. During the 13 weeks of last quarter the death-rate averaged 16·2 per 1,000, and was 3·4 below the mean rate in the corresponding periods of the ten years 1878-87. The 1,352 deaths included 39 from measles, 24 from scarlet fever, 35 from diphtheria, five from whooping cough, one from typhus, eight from enteric fever, 72 from diarrhœa and dysentery, and not one from smallpox, ill-defined forms of continued fever, or cholera; thus 184 deaths were referred to these diseases, being 21 below the corrected average weekly number. In Greater London 3,190 births and 1,680 deaths were registered, corresponding to annual rates of 30·1 and 15·9 per 1,000 of the estimated population. In the outer ring 23 deaths from diarrhœa, seven from fever, seven from whooping cough, six from diphtheria, and six from measles were registered. The deaths from diarrhœa included five in West Ham, four in Croydon, and three in Walthamstow sub-districts. The 20 deaths in Tottenham sub-district included three from fever, and three from whooping cough. Three fatal cases of measles occurred in Epsom, and two of diphtheria both in Godstone and in Walthamstow sub-districts.

FLINT INSTRUMENTS COLLECTED IN TUNISIA BY M. F. MOREAU.

THIRTY years ago flints intentionally wrought had scarcely been remarked. Now they are found in numbers in the most varied forms and in all regions of the globe where it has been possible to search for them, and thanks to them we are able to reproduce an entire past age of humanity. Hence their importance to the anthropologist and the archæologist. Man, in however savage a state, must have quickly comprehended the utility of the stones lying at his feet, both for the purpose of attack and of defence. He learnt to point them and to give them shapes best suited for his purposes. Everywhere these flints, sometimes split by fire or coarsely wrought, sometimes polished by persevering toil, present an analogy which strikes even the most hasty observer. "They are found," says an American scientist, "underneath the mounds of Siberia, in the tombs of Egypt, on the soil of Greece, among the rude monuments of Scandinavia; but from whatever region they come they are so identical in form, in material, in workmanship, that they might easily be taken for the work of the same artificers."

Does this similarity allow us to suppose ancient relations of which we can scarcely seize the traces? Or has man simply obeyed innate instincts, as do the other animals daily before our eyes? The former solution seems to the author the more probable, though we should incline to the second, adding that this is one of the numberless questions which it is easy to put, but which our present knowledge does not permit us to answer with the necessary certainty. We therefore follow with a lively interest the new discoveries, all destined to facilitate the examination of the grand problem which has occupied the philosophers of the past, as it will doubtless still engage those of the future.

M. F. Moreau, in the course of a recent voyage in Tunisia, has traversed a little known country between Gafoa and Tamerza. Dr. Collignon, whose researches on the pre-historic past of the region are well-known, has not been able to visit it. It is inhabited by a scattered population living in tents or under shelters constructed of branches, and migrating according to the weather. It was not thus formerly. M. Moreau has found in many parts true workshops where raw materials, fragments, nuclei, articles, just sketched or completed, lie in confusion on the ground, as they happened to be on the day when the workman, driven by circumstances of which we know nothing, forsook them for ever.

The climate in those days was probably more hospitable than at present. The remains of fossilised trees, and the remnants of more recent forests, attest that these regions, now so desolate, were formerly wooded. The disappearance of the trees has brought about that of the water, and has transformed fertile tracts into barren sands.

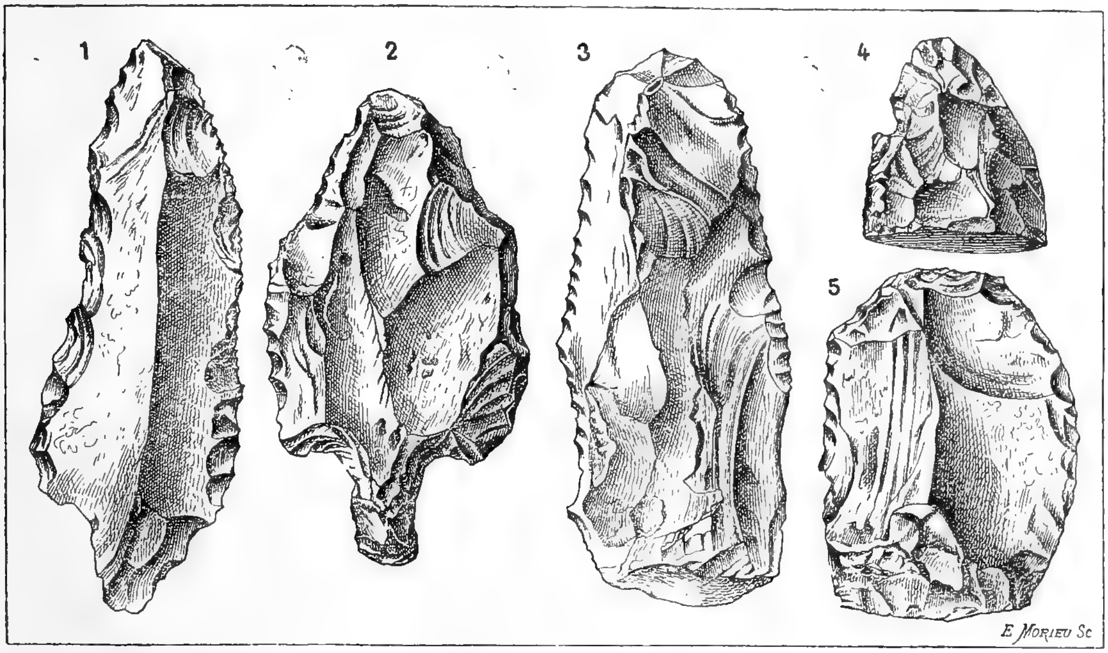


FIG. 1.—POINT OF JAVELIN FOUND AT TAMARZA. FIG. 2.—POINT OF A LANCE, FROM THE GORGES OF OUED-SELDJA. FIG. 3.—THICK AND MASSIVE BLADE FOUND AT BIR-SAHAD. FIG. 4.—FRAGMENT OF A LANCE-POINT DISCOVERED AT BIR-SAHAD. FIG. 5.—SCRAPER FROM BIR-SAHAD.

The cut flints brought by M. Moreau and shown in figs. 1 to 5, borrowed from *La Nature*, belong to an epoch to which no certain date can be assigned. Particular notice is due to a javelin-point derived from Tamerza; a lance-head with a stalk (for insertion in the shaft), found in the bed of a streamlet in the deepest of the gorges of Oued-Seldja; a massive blade, found at Bir-Sahad; a fragment of a fine point, carefully retouched on both surfaces, found at two kilometres from Bir-Sahad. This is, of all the specimens which he has collected, the one which M. Moreau considers the most remarkable in workmanship. All belong, as far as it can be judged from the figures, to "Mousterian" type, though we cannot pretend to prove them contemporaneous with the same type in Europe. M. Moreau has not found any fragment of pottery nor any characteristic bone which might permit of a more exact classification.

The discoveries of M. Moreau are not the only ones which have been made in Tunisia in the last few years. Those of Dr. Collignon have already been spoken of, and in 1844 the Marquis de Nadaillac presented to the Society of Anthropology numerous flint implements found by his son (then a captain in the 101st Regiment of the Line), in the neighbourhood of Cabes, several of which present a type very similar to those just described. They consist especially of arrow-heads, and, judging from their number, it is probable that there must have been a numerous population. There were also found hatchets, or at least fragments from the ancient bed of the Oued-Gabes, where they lie in a stratum of sand humus, covering a bed of gypsum. We may also cite a number of flints in the form of a crescent, very small, but bearing traces of careful workmanship. These crescents cannot have been for any use; they must have been amulets or votive stones deposited in sepulchres. M. Rivett-Carnac announces that flints of similar shapes have been found in the province of Banda, in India, and others are known as coming from the Caucasus. It is curious thus to find the same designs recurring in all latitudes and in all parts of the globe.

THE FORMATION OF PETROLEUM.

THE hypothesis of an inorganic origin of petroleum, advanced at one time by Professor Mendelejeff and others, is at present scarcely taken into consideration, whilst the question whether it has been derived from plants or from animals, must still be regarded as open. Both these have found their advocates down to the present day. Whilst the geologists, especially since Leopold Von Buch, assume the animal remains of earlier geological epochs—especially those of fishes, saurians, corallines, sepias, shell-fish, etc.—as the primary material of petroleum, the adherents of the other theory seek for the origin of these fossil hydro-carbons in the plant-world of those ages. Both parties agree, both on chemical and on geological grounds, that the formation of petroleum must have ensued under high pressure, but not at a very high temperature.

In consequence of experiments on the decomposition of animal fats, Herr C. Engler (*Deutsche Chemische Gesellschaft* and *Naturforscher*) has made observations which may serve as contributions to the theory of the formation of petroleum from animal matter.

By the distillation of 500 kilos. (about 1,000 lbs.) of fish oil from the Menhaden (*Clupea menhaden*) a large kind of herring caught off the east coast of North America, at pressures from 4 to 10 atmospheres, and at temperatures of 320 degs. to 340 degs. Cent., he obtained, along with gases and a watery liquor, about 300 kilos., or 60 per cent., of an oil which was resolved into three main fractions, boiling respectively at 150 degs., between 150 degs. and 300 degs., and above 300 degs. Cent. The portion boiling below 150 degs. Cent., consisted of a mixture of non-saturated and saturated hydro-carbons. Check experiments with the glycerides of oleic and stearic acid (artificially prepared), as well as with these fatty acids, alone gave analogous results. It may therefore be regarded as proved that animal fats under strong pressure are capable of conversion into hydro-carbons, as it is also the case with vegetable fats.

But though the conditions of the formation of petroleum from vegetable and animal matter may be regarded as identical, Engler points out certain facts which are strongly in favour of the latter source. There is, above all, the absence of any considerable deposits of plant remains in connection with oil-regions, and inversely, the absence of any abundant discoveries of petroleum among coal-beds. On the other hand, where oil is found in a primary deposit, animal remains can be regularly pointed out. Thus in the shelly limestone (*muschelkalk*), in the Carpathian fish shales, and in coral reefs, the occurrence of petroleum has been observed. Particularly interesting are the orthoceratites in the Trenton limestone at Packenham, in Canada, whose former living-cells sometimes contain several ounces of petroleum. Bituminous rocks display, as a rule, considerable quantities of animal remains.

The absence of nitrogen and its compounds in petroleum seems at first sight striking, and not in favour of their formation from animal matter. But the same fact might with almost equal justice be urged against their vegetable origin; for the remains of plants contain considerable quantities of nitrogen, as is proved by the extraction of ammonia from coal on a commercial scale. But, even disregarding the circumstance that nitrogenous compounds occur in many petroleums, we must consider the very unequal stability of the non-nitrogenous oils and of the nitrogenous muscular substance of the animal body. Engler recalls many observations on the formation of adipocire, "fat-wax," a product of the transformation of the fats during the decay of animal remains. This substance, which often contains as much as 98 per cent. of fatty acids, is still found even when the nitrogenous matter and the very bones have disappeared. Thus in the accumulated animal remains of the primitive world the decomposition may have proceeded in two main phases. The nitrogenous compounds were decomposed, the nitrogen escaped either in the free state, or in that of ammonia and other compounds. The fat remained behind or was transferred to secondary localities, where it was finally converted into petroleum.

The absence of carbonaceous residues in mineral oils must be interpreted as militating against a vegetable rather than an animal origin. The poverty of cellulose in hydrogen, in case of a decomposition at a low temperature (whereby the formation of carbonic acids is trifling, as compared with the formation of water), must necessarily involve a more abundant liberation of carbon. It is different in animal fats or in the fatty acids thence resulting. If in these all the oxygen with an equivalent proportion of hydrogen be eliminated as water, there remains carbon and hydrogen in an approximate proportion of 87 per cent. carbon and 13 per cent. hydrogen. But this is, as Engler shows, very near the general composition of crude mineral oils. His experiments have also shown that fats and fatty acids under pressure in a sealed tube are often resolved into gases and volatile hydrocarbons without any important separation of carbonaceous residues. Engler, therefore, maintains that petroleum is essentially of animal origin, especially as the ancient marine flora was very small in quantity in comparison with its fauna.

THE BUFFON CENTENARY.—At a commemoration of the hundredth anniversary of the death of Buffon, discourses were pronounced by M. Guillaume, a connection of the Buffon family, and by M Grandidier, on behalf of the Academy of Sciences.

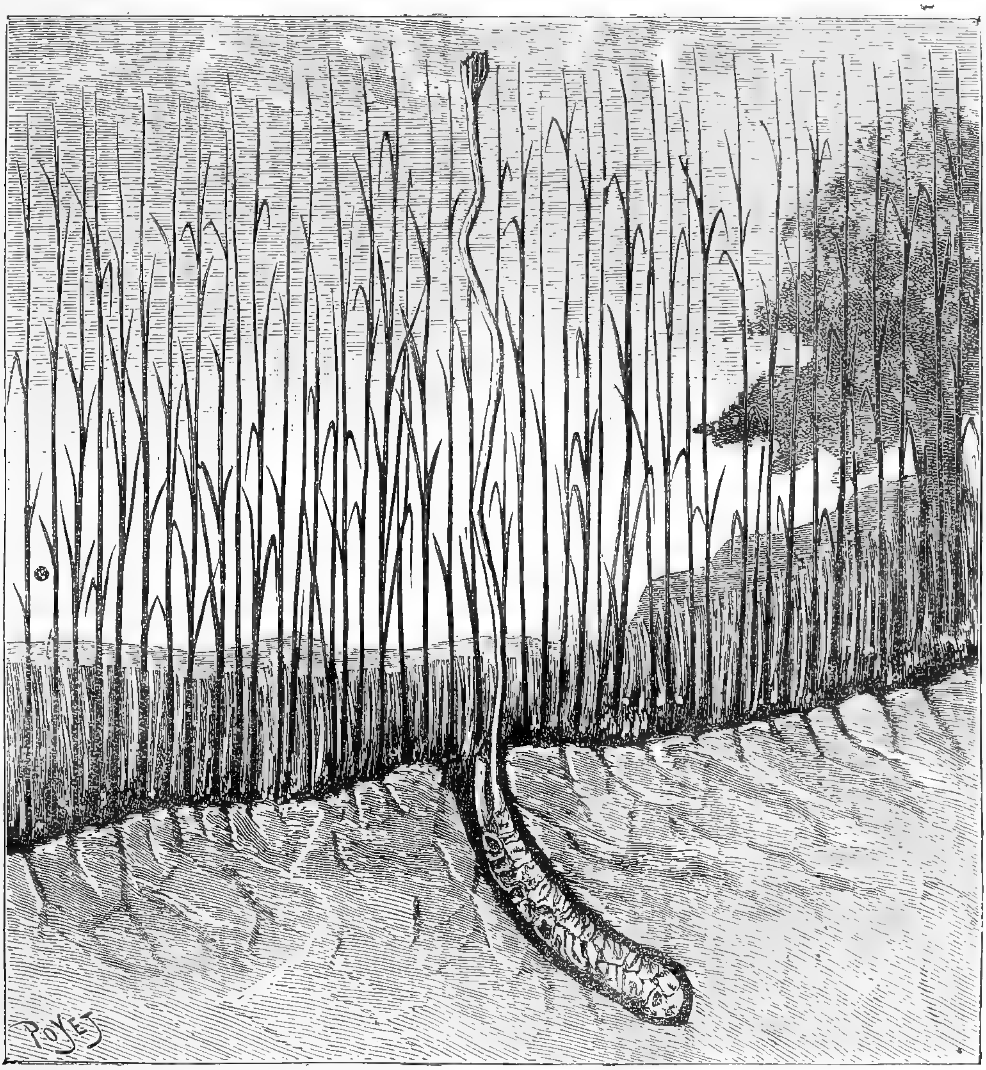
Natural History.

A CURIOUS FUNGUS.

THE dietetic relations of animals and plants are not yet thoroughly known. Every one is aware that there are animals which seize upon some other animal or some plant and devour it entirely an open, straightforward manner. We are equally familiar with the fact that other animals live parasitically; they introduce their ova into the bodies of other animals or of plants, these ova, when hatched, preying gradually upon their host, absorbing its juices, and in many cases destroying it outright. Such parasites are the intestinal worms which haunt man and the lower animals, the "warbles" which perforate the hides of cattle, the ichneumons which insert their eggs into caterpillars, the weevils which in like manner oviposit in the buds of plants, so that the young grub may prey upon what should have been the fruit.

But it is less generally known that there are plants which turn the tables upon the animal creation. The late Charles Darwin, as well as other naturalists, has called attention to the so-called "carnivorous plants" which capture insects and consume them bodily. But a less known case is that of a plant, generally of very humble rank, which lives parasitically upon some animal, and appropriates its body.

One of the simplest instances of this kind of parasitism is when an ordinary mould attacks some living insect in the larval or pupal stages. Entomologists, in searching for the pupae of moths, whether in the earth or among decaying vegetation, not unfrequently find them invaded by mould; such specimens, of course, come to nothing.



Cordyceps Robertsii, GROWING FROM THE PUPA OF *Charagia virescens*.

A much more decisive and instructive case is that of the "fly-fungus" (*Empusa muscae*). In autumn we may occasionally perceive sitting on the window-pane a common house fly, with which there is decidedly something amiss. Its movements are feeble and sluggish, and at last it seems to become fixed to one spot, where it dies. The glass around it appears to be covered to the extent of perhaps a quarter of an inch with a whitish film. If the observer can persuade such a fly—as we have done more than once—to die upon a slip of glass that can be placed under the microscope, he will see that its body and the glass around is covered with the fungus, which has, in fact, fed upon the fly and destroyed it as decidedly as a spider might have done, though more gradually, and without any conspicuous mark of violence. If this fungus be applied to the body of other flies, especially near the spiracles, the latter become infected, and perish in like manner.

Attempts which we made some years back to impart this disease to blow-flies, gnats, and to the blood-sucking *Stomoxys calcitrans*, did not prove successful. But there are cases of other plants taking root in or upon living animals with a fatal result.

A certain species of wasp is said to be occasionally thus attacked. The botanical journal *Flora* reports that the fungus *Torrubia cinerea* has been found growing upon a mature *Carabeus*.

Count d'Ursel, in a recently-published work on South America, asserts that in Bolivia, Peru, Chili, La Plata, and Brazil he has met with an insect which, after its death, is "transformed" into a plant. He describes and figures this creature as a "thick, hard grub, with distinct articulations." When about to die it buries itself a couple of inches in the earth, and then gradually increases in bulk until it presents an appearance very like that of a potato. A stem is then put forth, which in the spring months bears a crop of blue flowers. We do not accuse the Count of dealing in romance, but we suspect that he has misunderstood the phenomena which he has witnessed.

A somewhat similar case is that of the so-called "Bull-rush caterpillar" (*Cordyceps Robertsii*) of New Zealand. A specimen of this insect and of the plant which issues from its remains has been lent to us, and is shown in the accompanying figure.

The plant, which is called by the Maories "Awheto," and which is by no means rare, grows chiefly at the root of the "rata" (*Metrosideres robusta*). The body of the caterpillar, which is found underground, is in some instances as much as $3\frac{1}{2}$ inches in length. The one which has been submitted to us is of a brownish colour, hard to the touch, and of a shrivelled appearance, like that of a caterpillar which has perished from want of food, or which, though fully fed, is unable to effect its transformation into a pupa. The horny portions of the head, the jaws, and some of the feet can be distinctly identified. From the nape of the neck—speaking in non-technical language—proceeds a stalk which may reach the length of six inches. At its summit is a fructification resembling the "club-headed bull-rush" on a reduced scale. There are no leaves, and if the stem be accidentally broken off, a second stem shoots up at its side. The natives eat the plant, which when fresh has, they say, the flavour of a nut. It is also burnt, and in that state is used as a colouring-matter in the tattooing process.

We are far from considering this ill-named phenomenon as a link between the animal and the vegetable kingdoms, or as the transformation of a caterpillar into a plant. The facts as described to us must be interpreted as follows: the caterpillar, burrowing in the soil to undergo there its transformation into a chrysalis—as do many species—encounters some of the spores of a fungus. One of these takes root in its body at a part which the caterpillar, even if lively, cannot reach to free itself from the intruder; it there nourishes itself on the juices of the body, which perishes as it vegetates. Whether the same fungus attacks any other kind of caterpillar is a question not yet decided.

The fungus in question is said to be nearly related to the "ergot," which is parasitic upon rye and sometimes upon other kinds of grain.

Ants and Butterflies.—In the last number of the journal of the Bombay Natural History Society, Mr. Lionel de Nicéville describes the manner in which the larvæ of a species of butterfly (*Tarucus theophrastus*, Fabricius) are cultivated and protected by the large common black ants of Indian gardens and houses. As a rule, ants are the most deadly and inveterate enemies of butterflies, and ruthlessly destroy and eat them whenever they get the chance, but in the present case the larvæ exude a sweet liquid of some sort, of which the ants are inordinately fond, and which they obtain by stroking the larvæ gently with their antennæ. Hence the great care which is taken of them. The larvæ feed on a small thorny bush of the jungle, the *Zizyphus jujuba*, and at the foot of this the ants construct a temporary nest. About the middle of June, just before the rains set in, great activity is observable on the tree. The ants are busy all day running along the branches and leaves in search of the larvæ, and guiding and driving them down the stem of the tree towards the nest. Each prisoner is guarded until he is got safely into his place, when he falls off into a doze and undergoes his transformation into a pupa. If the loose earth at the foot of the tree is scraped away hundreds of larvæ and pupæ in all stages of development, arranged in a broad, even band all round the trunk, will be seen. The ants object to uncovering them, and immediately set to work to put the earth back again; if this is taken away again, they will remove all the chrysalids and bury them lower down. When the butterfly is ready to emerge in about a week it is tenderly assisted to disengage itself from its shell, and, should it be strong and healthy, is left undisturbed to spread its wings and fly away. For some time after they have gained strength they remain hovering over their old home. In one case a butterfly fell to the ground before its opening wings had dried, and a soldier-ant tried to rescue it. He carried it back to the tree with the utmost care, and made several attempts to assist the butterfly to hold on again, but finding his efforts unavailing he left the cripple to recover himself. On his return, seeing no improvement, he appeared to lose all patience, and, rushing in, bit off both wings and carried the body into the nest. But high-handed proceedings of this kind are very unusual. It is said to be a curious sight to watch the fragile and delicate butterflies wandering about, all feeble and helpless, among the busy crowd of coarse black ants, and rubbing shoulders in perfect safety with the ordinary fierce, big-headed soldiers. A larva of another species thrown down among them as an experiment was immediately set upon and torn to pieces by the ants.

Intelligence of a Cat.—M. G. Vayssié de Veragne gives, in *La Nature*, the following curious incident, referring for confirmatory evidence to M. Palmaroli, Director of the Academy of the Fine Arts at Rome. An old convent on the Janiculum is covered with convex tiles, which advance to the edge of the roof. and project over. This arrangement is favourable for the construction of nests, and accordingly a flock of pigeons have established themselves there. One day a stray, half-starved cat, which had taken up its quarters at the Academy, was seen on the roof. Quite near it, and close to a nest, two pigeons were resting, quite ignorant of the danger. But instead of seizing the birds, pussy waited till they flew away, and then advancing very carefully she reached the edge of the roof, thrust her paw under a tile, raised it gently, and looked down into the nest. With our opera-glasses we could see the eggs, and expected that she would break the shells and devour the contents. Not at all; she made a conscientious review of all the nests, and went away very philosophically. For a week, at sunset, this proceeding was repeated; the cat arrived punctually, made her visit of inspection, and departed. One fine day we could see young pigeons in most of the nests. The visitor came as usual, examined everything, and again departed. One of us said, laughing, "She is waiting until they are in good condition." Such was the case. In a few days the marauder lifted up a tile, and did not replace it; she thrust her head into the hole, and reappeared, holding a young pigeon, which she devoured forthwith. This is not all; so methodical was the cat that she never took more that two pigeons, but one evening, when she was about to seize her dinner, the coveted prey sprung from the nest and flew away. The cat took an attitude of indefinable stupefaction, but soon recovering she made a complete raid under all the tiles, and in the morning we found in the bell-tower the remains of ten young pigeons.

COCKCHAFERS IN AUTUMN.—M. Dufeu (*La Nature*) states that he has this year found cockchafers during the month of September, their usual time of appearance being in May. When digging in his garden at Varenne-Saint-Hilaire (Seine), he has just found one at the depth of eight inches.

THE SHEEP FLY (LUCILIA SERICATA).

SEVERAL instances are known of a change, gradual or sudden, in the diet of an animal species not by any means due to a deficient supply of what the older zoologists would have called its "natural food." Semper relates in his work on "The Conditions of Existence of Animals," that sea-gulls have been known to cease preying upon fish and feed upon grain. On the contrary, bats have in South America taken to fishing instead of pursuing moths.

The New Zealand parrot (*Nestor mirabilis*), formerly nourished itself on the juices of plants and flowers, but has now developed an amazing propensity for sipping the blood of sheep. The blue-nosed baboons of South Africa are occasionally guilty of killing and devouring sheep.

Similar changes of habit are met with more frequently in insects. Considerable attention has been latterly attracted to a small carrion-beetle (*Silpha atrata*) which has turned vegetarian, and proves very destructive to the mangel wurzels and sugar beets. A very curious case of this kind is described by Ritzema Bos, in the *Biologisches Centralblatt* and the *Naturforscher*. A well-known fly (*Lucilia sericata*) has become a dangerous parasite of sheep, by a change in its food during the larval stage.

Like the maggots of many *Muscidæ* the larvæ of *Lucilia sericata* generally lived in dung, or in the flesh of dead animals. Karsch considers the species in question as a genuine blow-fly, whilst Ritzema Bos has found its larvæ able to live in sheep's dung. In many districts of the Netherlands, the maggot now infests the flesh of living sheep, and in seasons favourable to its development, it occasions a really formidable epidemic among them. This new plague is most to be dreaded in the luxuriant marsh-pastures of North and South Holland, Friesland, and Groningen, whilst on poor, sandy, and heathy soils the sheep suffer little. According to Ritzema Bos the flies are induced to deposit their eggs in the excrement which often adheres to the wool of sheep. Less frequently do they attack parts of the animal which are free from such impurity. In ovipositing, the fly alights upon the body of the sheep and fixes its eggs to the wool in groups of ten to twenty, until about 500 have been deposited. Their development depends on the weather, but it takes from twenty to forty hours, when the maggots, closely resembling those of the blow-fly, creep out and reach their full growth in from fifteen to twenty-four days. The larvæ then leaves the body of the sheep and falls to the ground. Here it remains lying among the grass of the pasture, and is transformed into a pupa. Several generations succeed each other in the course of the summer, and the larvæ of the last generation probably creeps into the ground and pass the winter their as pupæ.

The symptoms of the disease produced in sheep by these larvæ depend firstly in the irritating action of the larvæ upon the skin. The skin then secretes a serum-like, offensive liquid, which gives the wool a bad colour, and makes the hairs adhere together. The skin, in consequence of the grubs creeping over it and boring into it, becomes hot, of a blood-red colour and swollen. When the mature parasites have left the sheep, the superficial inflammation heals, though the wool falls off in consequence of the elimination of the thickened layers of the epidermis. Most commonly, however, the injury occasioned by the first brood of maggots is intensified by those of the following generations, and as there are flies all the summer which deposit their eggs, the disease grows constantly worse. It extends not merely forwards from the hind-quarters of the sheep, but the larvæ penetrate deeper and deeper, not merely into the subcutaneous cellular tissues, but into the muscles, which they mine and consume.

The occurrence of this maggot-disease in the Netherlands cannot be traced with certainty, though it seems to have been first observed about 1860. An alleged introduction from England (!) cannot be demonstrated, as the disease attacks all races. It is rather to be assumed that the fly, which is a native of the continent of Europe, has assumed parasitic habits in the Netherlands in the manner already described. Hitherto sheep have not been attacked in this manner in Germany. This deserves notice, as the fly, which is described as rare by Karsch, is now very common in North Germany, Whilst the zoological collection in Berlin till lately possessed only two specimens from Styria, it is now caught freely on putrid flesh laid as a bait. Hence the question arises whether *Lucilia sericata*, as well as *Sarcophila wohlfahrti*, may not be concerned in the numerous cases of *Myasis* in man which have been observed in Europe.

The common lurid green *Lucilia cœsar* and *Lucilia sericata*, likewise of a green colour, are distinguished chiefly by the position of the eyes in the male. In *L. cœsar* they almost touch on the head, whilst in *L. sericata* they are separated by a black line. The females are distinguished by the frontal line, which in *L. cœsar* is black, but in *L. sericata* grey-brown and narrower.

WORK FOR NATURALISTS' CLUBS.

IV.—Leaves.

COLLECT a number of leaves of various kinds, deciduous and evergreen, long and round, simple and cut. Elder, laurel, hyacinth, lilac, tropæolum, ash, horse-chestnut, and grass will make a good selection.

Notice the effect of situation upon the *form* of the leaves. Social plants, such as grasses and daffodils, have often narrow leaves, which do not shade one another too much. Here and there a masterful intruder, like the daisy, dandelion, or shepherd's purse forces its way in among them, forming the selfish arrangement known as a rosette. A circle of broad leaves pressed tightly against the ground keeps a clear space which competitors cannot enter, If you cut out the root you will see how effectually the rosette-forming plant keeps its little patch of ground to itself. Leaves carried upon the boughs of trees are often much divided, so as to bend and fold together in a high wind. Floating leaves and leaves of marsh-plants are usually of very simple outline, for they have few competitors, and are little liable to get in one another's light. Submerged leaves are generally cut into narrow segments, but the reason is not very clear. Some naturalists suppose that they need to expose as large a surface as possible, in order to extract the minute proportion of carbonic acid dissolved in a vast bulk of water. Lubbock ("Flowers, Fruits, and Leaves") and Grant Allen have discussed the shapes of leaves in a very interesting and profitable way.

The *surfaces* of leaves give a wide scope for observation and discussion. How much there is to tell about hairs! There are glandular hairs to catch or deter small creeping insects; hairs set in weels, as effectual a protection against young animals as a spiked palisade against roving boys; hairs which keep off browsing quadrupeds, like the hairs on some common grasses, which cattle never touch; then there are hairs which keep the little drops of moisture (dew-drops, for example) from dispersing, and force them to run together into big drops, which roll down the channelled leaf-stalk, and so wet the earth about the roots; lastly, there are hairs which, like those of the nettle, are poisoned stings. We forget the vexation of the nettle-rash when we observe the ingenuity of the mechanism by which it is caused. The nettle-hair is provided with a brittle and pointed siliceous cap, which breaks off in the wound. Then the poison is able to flow out through the tubular hair from a reservoir at its base, and aggravate the tiny puncture. We cease to wonder that nettles are let alone by nearly all animals except jackasses, when we consider how admirably it is protected. The success of the invention is attested by the number of fraudulent imitations. Ever so many "dead nettles," plants with the outward form of the nettle, but innocent of offence, profit by their artful resemblance to the dreaded stinging-nettle.

But we must get away from the hairs of leaves, if our article is to keep within any reasonable limits. Kerner, on "Flowers and their Unbidden Guests," is well worth looking into on the subject of defences against gnawing insects. The leaves of evergreens are protected by their glossy surface from rain and dew, which might freeze upon them, to the great injury of the tissues within. Half-melted snow cannot be kept off so easily, and this, followed by frost, is sometimes very deadly.

The *stomates* of leaves are easily found. Notch the surface of a succulent leaf, say hyacinth, with a razor or sharp knife. Then catch the edge of the surface between the blade and the thumb. Strip off a small piece of the epidermis, and mount in water. If the air-bubbles are troublesome, momentary warming over a spirit-lamp, or the addition of a drop of alcohol, will be useful. Common books describe the structure of the stomates, but they often give a mistaken account of their use. The stomates serve for the regulated escape of water-vapour, not for the absorption of gases. It has been experimentally proved that the upper surface of the leaf absorbs quite as much carbonic acid as the lower, and yet it is the lower which carries nearly all the stomates. The mechanism for regulating the orifice of a stomate depends upon the power which the guard-cells possess of rapidly absorbing water when stimulated by sunlight, and upon the ease with which they give up their water in the dark. A simple model will make the action of turgidity in opening the stomate quite obvious. Fix to an upright board a loop of good indiarubber tubing. One end of the tube is to be clamped to the board, so as to hold and close it at the same time. Secure the top of the loop by a hook and pass the other end of the tube through a brass tube, tight enough to prevent it from slipping, but not so tight as to choke the passage. The two limbs of the tube should be drawn into a parallel upright position, when they will roughly represent the guard-cells of a closed stomate. Now pass the open end over the nozzle of a water tap (if a good pressure is at command) or of an oxygen bottle. Apply the pressure gradually, and observe how the two limbs of the tube separate from each other as they become distended.

Then *sections* through leaves and leaf-stalks will, of course, be studied. Bower and Vines' "Practical Botany" may be recommended as a useful guide to the demonstration. The epidermis, with its hairs and stomates, the palisade cells towards the upper surface (in "bifacial" leaves), the spongy tissue towards the lower surface, the air-spaces, and the vascular bundles, will easily be made out in a good, thin section of the leaf. The palisade-cells, set at right angles to the surface, permit the chlorophyll-corpuscles to avoid exposure to an over-intense light by ranging themselves along the side walls of the cells. If we were troubled with a light too intense for our eyes, and had no notion of making window-blinds or curtains, we should probably alter the shape of our rooms, especially if bricks were semi-transparent, like cell-walls. We should build long and narrow rooms, lit only at one end, and take care not to sit facing the light. This is what the chlorophyll corpuscles do, and the palisade-cells give them every facility for executing the manœuvre. Observe that upon the very same tree, leaves fully exposed to the light become thickened, while those that are half-shaded remain thin as fine paper. The difference is very apparent in the beech. By thin sections, it can be shown that the thick leaves have three or more rows of palisade cells, the thin leaves often only one. Where a leaf is exposed to full light on both sides, as is the case with the erect leaves of the hyacinth or daffodil, it becomes "centric," *i.e.*, palisade-cells are formed on both sides.

In the *leaf-stalk*, notice the vascular bundles, the tough and elastic collenchyma (cells with thickened angles), and the air-spaces. If a good section is got, it will be vastly improved by treatment with Schultze's

Fluid (iodised zinc chloride). Observe that the air-passages extend continuously through the leaf and leaf stalk. Gather a long-stalked leaf, *e.g.*, of buttercup; put the leaf into the mouth, close the lips upon it, and pass the cut end into a beaker of water. Blow hard, and a stream of small bubbles will issue from the end of the stalk. At the base of the leaf stalk may often be seen a pulvinus, or cellular cushion, which causes the daily movements of erection and drooping. Under the stimulus of light the cells become turgid, and erect the leaf. In the dark, water is given off, and the leaf droops. The interesting chapter on the "Sleep of Leaves," in Darwin's "Movements of Plants," should be consulted on this point. In the sensitive plant, large pulvini are found, not only at the base of every leaf, but of every leaflet, and mechanical irritation, as well as darkness, can excite the unequal turgescence which makes the whole arrangement collapse.

The different sorts of *specially modified leaves* cannot be described in our brief notes, but we may at least enumerate the leaves which serve as traps to digestive organs (pitcher-plants, sundews, pinguicula, utricularia), and the leaves which become transformed into tendrils, spines, or glands. Leaf-arrangement, leaf-folding, leaf-colours are mentioned only to show how inexhaustible is the subject.

Reviews.

Planetary and Stellar Studies; or, Short Papers on the Planets, Stars and Nebulæ. By John Ellard Gore, F.R.A.S., M.R.I.A., F.R.G.S.I. London: Roper and Drowley.

Mr. J. E. Gore, who must not be identified with another scientific author, Dr. Robert Gore, F.R.S., has here furnished us with an exceedingly able account of the heavenly bodies, and certain collateral subjects.

In the brief Introduction the author refers to the accuracy of the observations of the ancient Chaldean and Egyptian astronomers, who, though not possessed of telescopes, had the advantage of an atmosphere far more transparent than that of Western Europe. He then proceeds to a description of the planets. When speaking of Venus, he refers to the strange notion prevalent in November and December, 1887, that this planet was a return of the "Star of Bethlehem." He concludes that Venus has no satellite of a size sufficient to be visible with our telescopes. On the alleged mountains of Venus the author is silent.

Next comes Mars, a planet which has lately excited much attention on account of his "canals." On their nature Mr. Gore gives no opinion. He mentions that the areas of land and water on the surface of this planet are about equal, and he is of opinion that from the close proximity of the satellites to the body of the planet they will have little efficacy as illuminators, and from their small size they can produce but feeble tides in the seas.

In considering the planet Jupiter we find mention of the probable high temperature of this planet, of the red—possibly incandescent—spot on its disc, of the enormous depth of its atmosphere, and of the coincidence in time of occurrence between its spots and those of the sun.

Saturn, Uranus and Neptune are all noticed in due course, but there is no mention of the suspected existence of one extra-Neptunian planet if not more.

It will be noticed that in his account of the solar system, Mr. Gore makes no mention of the two, to us, most conspicuous bodies, the sun and the moon.

In his eleventh chapter the author examines the double, triple and multiple stars, the number of which is now found greater than it was formerly supposed. The phenomena of the variable stars are next considered, and the current explanations are mentioned, none of which the author thinks fully satisfactory. Under "nebulæ" the author recognises the fact that spectroscopic observation proves many to be accumulations of glowing gas, thus giving strong confirmation to the celebrated "nebular hypothesis."

In speaking of the distance of the fixed stars, the author refers to the opinion of the late Mr. Proctor, that the brilliancy of a star is no test of its distance, and that the more conspicuous of these bodies owe their greater brightness, not to relative proximity to the earth, but to real superiority in size.

One of the most interesting sections of this work is that dealing with the "Great Pyramid and the Precession (erroneously written *procession* in the Table of Contents) of the Equinoxes." Certain "astronomers and physicists, including the Abbé Moigno (the late distinguished editor of *Cosmos* and Mr. Piazzi Smyth), contend that the builders of the pyramid ascribed to Cheops, embodied in this vast structure a number of the most important scientific data. Among other things, it is said that the precession of the equinoxes is indicated by certain of the measurements of the pyramid. This phenomenon, *i.e.*, the rotation of the pole of the equator round the pole of the elliptic in a period of 25,000 years, is due to the revolution of the sun around some central body in that period of time. This supposition the author shows to be erroneous.

Under "Changes in the Stellar Heavens," Mr. Gore treats of the observed motions of the so-called fixed stars, and also of the appearance, often sudden, of stars periodically unnoticed. Thus, that observed by Tycho Brahé in 1573, was visible even in daylight, but within five months it disappeared to the naked eye. Its light was at first white and extremely bright, then in succession yellowish red, and lastly, of a pale-livid colour. Similar, if less striking, cases have repeatedly been observed by eminent astronomers.

We regret that we cannot, on account of space, prolong our examination of this most interesting work. We must regard it as at once readable and accurate, and we most commend especially the author's judicial reserve on points not proven.

Proceedings of the Bristol Naturalists' Society. New Series, Vol. V., Part 3 (1887-8). Bristol: The Society.

This volume contains much matter which was well worth putting on record. Professor C. Lloyd Morgan contributes an interesting memoir on "Elimination and Selection." *A propos* of Mr. A. R. Wallace's critique of the phrase "natural selection," Professor Lloyd Morgan suggests provisionally the use of the phrase "natural elimination." He remarks that "too little importance has, perhaps, been attached of late years to the mental element in evolution. In Lamarckism it took a foremost place. In the reaction against Lamarckism the mental element fell into the background. But those naturalists who have kept abreast of philosophy are more and more coming round to the view that mind and body are indissolubly connected; that the mind does not act *ab extra*, but is an integral and essential part of the organic whole." He admits that we are still in the dark about origins. Elimination originates nothing. Selection originates nothing. We are thrown back upon variation, bodily and mental, as the origin. But how originates this variation? In response to surrounding conditions. True; but how?

Mr. A. J. Harrison, M.B., furnishes a paper on "Seals and their so-called Ballast Bag." He proves that the alleged "ballast-bag" is merely the stomach, and he gives us very satisfactory evidence that the stones swallowed are not to serve as ballast, but to aid in the comminution of the food in the stomach. "Seals seize their prey greedily, and swallow it rapidly, their trenchant teeth not being adapted for much mastication; but the presence of a number of round smooth bodies in the stomach, such as these pebbles, would assist very materially in breaking up the food."

"The Crossing of Ferns," by Colonel Arthur M. Jones, is also an important paper as containing definite evidence on the fertility of hybrids. It was indeed pronounced "an established fact" by Sir Joseph Hooker in a letter to Mr. E. J. Lowe, written in 1884. The latter gentleman succeeded in raising a hybrid between *Polystichum angulare* and *P. aculeatum.* The hybrid has been proved by Col. Jones and others to be easy of reproduction from spores.

At a meeting of the Entomological Section of the Society there was exhibited a hermaphrodite specimen of *Odonestes potatoria*, one side being male and the other female. The contrast between the two antennæ was remarkable. We find, however, no indication that the insect was dissected. Another exhibit was a hybrid between two well-known hawk-moths, *Smerinthus populi* and *S. Ocellatus.*

The Midland Naturalist. September, 1888.

This issue contains a very interesting paper by the Rev. H. H. Slater, entitled "Insularity," though its bearings would scarcely be inferred from the title. It is substantially a condemnation of that peculiarity among our naturalists which we have elsewhere felt bound to protest against as the "British mania." Our readers are, of course, aware that a multitude of ornithologists, entomologists, and botanists confine their collections and their studies to the fauna and flora of the United Kingdom. For a British or alleged British specimen of some rare bird, or egg, or insect, they are willing to pay considerable prices, whilst an identical specimen, caught or found on the other side of the Channel, they will scarcely accept as a gift. It has often been shown that no similar feeling prevails in any Continental country. A French entomologist may be exceedingly careful to put on record the locality of any specimen which comes into his hands, but he will not attach a higher value to it for having been caught in France rather than in Belgium, Germany, Switzerland, Italy, or Spain. It has also been pointed out that this same craving for British specimens is one of the main causes contributing to the extirpation of our finest birds and insects.

Mr. H. H. Slater argues against the British mania on the ground that Great Britain does not form anything like a natural zoological or botanical region. Had Britain been separated from the Continent by a deep sea, as is Madagascar from Africa, we should have had an independent fauna and flora the peculiarities of which, in contrast to those prevailing on the European mainland, would probably have been most instructive. The author adds, most justly: "We should undoubtedly have a far higher claim to the possession of true scientific knowledge if we were to confine our attention to one moderate-sized genus of mammalia, birds, insects, mollusca, or plants, and work out the distribution of that genus in the world zoologically (or, in the case of plants, botanically) and palæontologically, and familiarised ourselves with every member of that genus, its area, economy, habits, and uses, than by ever so general a study of the whole class as exemplified only in Britain."

Will any of the younger naturalists included among our readers take this advice?

The author asks, further, why, in these days of easy and cheap travelling, we hear of so few botanical, entomological, and geological trips on the Continent? We might further ask, why do the multitudes, whom business or pleasure call to the Colonies, not do something there for natural science?

Forest Culture and Eucalyptus Trees. By Ellwood Cooper. San Francisco: Cuberry and Co.

This little work consists of several district portions, very unequal in their value. The author's lecture on the cultivation of the Eucalyptus, in California, may be of great interest to the inhabitants of the United States, but will excite little curiosity elsewhere. At the same time we cannot help asking whether the sanitary value of these trees is quite as high as is popularly supposed.

It is said that the experiment tried in the Pontine Marshes has given very doubtful results.

The three essays, or lectures, delivered by Baron Müller, F.R.S., the Government Botanist for Victoria, one on "Forest Culture in its Relations to Industrial Pursuits," another on the "Application of Phytology to the Industrial Purposes of Life," and the third on "Australian Vegetation," are of great importance, especially as in their original form they are not easily met with. We have never seen the policy, or rather, the necessity of maintaining the forests enforced at once so practically and so philosophically. The two other lectures show the resources and the capabilities of Australia, and explain how they may be developed.

The concluding portion of the book, an account of the Santa Barbara College, in California, derives its sole and slender connection with the rest of the contents from the circumstance that Mr. Ellwood Cooper delivered his lecture on the Eucalyptus before this college.

Abstracts of Papers, Lectures, etc.

YORKSHIRE ASSOCIATION OF SANITARY INSPECTORS.

At the quarterly meeting held Sept. 27th, at Bradford, Mr. William Warner (Nottingham) read a paper on "Destructors and Refuse Furnaces," in which he said the development of this burning method had been no easy matter, and at the present time it had to fight many severe battles. If they analysed the opposition in the council chamber, at public meetings, or in the House of Commons, they could not find any just or reasonable cause to stop its progress; indeed, a careful study of the points raised would show to the unprejudiced mind that all these objections were raised without foundation. It had been proved beyond doubt by competent authorities that the method was the best and only safe one to prevent the propagation and spread of infectious diseases. Yorkshire was one of the first to enter the field and show the world the shrewdness of its inhabitants. Leeds had its first destructor built in 1877, and it appeared to have sufficiently satisfied the Corporation of that town, as a second was built in 1879. In 1881 the system was taken up with great spirit, but in 1883 no new destructors were adopted, a circumstance probably accounted for by threatened injunctions in some of the towns where the furnaces were in operation. After an examination of the evidence of the best medical authorities, one was led to imagine that it could not be possible to obtain a verdict against the use of furnaces for burning refuse if constructed upon experienced principles. At a recent Local Government Board inquiry Inspector Tidy stated he considered the destructor, with the cremator, an enormous advantage in sanitary work. Professor Wanklyn, in a report on the subject, gave the results of his investigation, and stated that "at these temperatures, and in presence of the accompanying air, all septic poisons are destroyed, and organic compounds are resolved into carbonic acid, water, and nitrogen gas; only the minutest traces of empyreumatic products could survive and pass away through the shaft into the general atmosphere. No harm to the health of the community is to be expected or feared from these products." Considering the valued opinion of medical authorities, why did they hear objections to the system on sanitary grounds? Why did they have agitation and threatened lawsuits? He attributed the objections to reasons which might be summed up as follows:—1st. Supposed depreciation of property in the neighbourhood where destructors are erected. 2nd. The traffic in refuse to the destructor depots. 3rd. Prejudice and individual causes. The first objection might be explained in assuming that people would not live where they were subjected to a nuisance or injury to health caused by noxious gases emitted from the burning; but it had been proved by experience that houses were equally well let in the neighbourhood of such furnaces, and that people who lived near them did not leave their homes to find a more ozonised atmosphere. The second objection might be formed with substantial reason in some towns, where the collection of refuse was let by contract. But the contract could be let under stringent regulations or even with more satisfaction done by the local authorities themselves. They could show by the evidence of medical men that where destroyers had been started the death-rate had been reduced. He described destructors which had been patented, and the cost of some of those which had been constructed. Taking the results generally, a chimney 160 ft. high was found very suitable, and its internal dimensions should be determined in accordance with the number of cells employed, and the probable rate of refuse treatment. A chimney this size with moderate foundations and good levels on site, could be built with a 6-cell destructor for about £3,000; but if they took the cost of several which had far exceeded proportionately that expenditure, the system would show itself favourably against other methods. Another important financial feature was formed by the high temperature produced in burning refuse, where sufficient power was found to do useful work after leaving the cells. At Leeds, Bradford, and Heckmondwike it was utilized during the daytime to grind the clinker into mortar, which was a good source of revenue to the Corporations. Batley proposed to work their sewage machinery as done at Ealing. There was no town, with the exception of Warrington, that used its power to the fullest extent. The amount of power available depended upon the construction of the furnaces, the quality of refuse, and regular method in working. Taking an average basis, Leeds was capable of producing 120-horse power from their 20 cells in winter, or if they calculated the consumption of 3lb. of coal to each horse and coal at 10s. per ton, they saved the actual value of £500 per annum in heat alone. He had shown how they had collected and burnt the refuse, and utilised the products of combustion, but there was another part of the system which must be taken into account. The refuse consisted of mineral and organic matter, with moisture; the former was not combustible, and would not reduce in bulk, but when acted upon by the heat it changed its form, and was fused into hard clinker. The organic matter with carbon, left a small residue of ash, and the moisture was evaporated entirely during the process. The component parts of the clinker were naturally hard, and when in a fused state were serviceable for many purposes. When broken up and mixed with lime or cement, it would stand as concrete for the best foundations; it was used extensively for forming road bottoms, and some towns obtained good saleable mortar by grinding it with lime and water in a mortar pan. In the year 1886 Leeds received £394 for mortar, Bradford £1,204, and Bolton £1,757. The fine ashes produced from refuse furnaces were extensively used for bedding granite stones in roadways and pleasure ground foot paths, and the fine dust from the flues had found a market with farmers. If a town could utilise the whole of the clinkers, fine ashes, and flue dust, it would not only pay for the cost of burning and the repayment of capital expended on the plant, but would also produce a revenue to aid the necessary cost of collection. He did not see why this point of perfection should not be reached. Referring again to the question of situation, he observed it was said that destructors should be erected outside a town, and some distance from dwellings, but his experience was that the greater number of complaints were received in those towns where the furnaces were thus situated. He believed that if a destructor of the latest type could be built during a night, unseen, and put to work without the knowledge of the surrounding inhabitants, no one would detect any difference, and no one would complain. Would health towns like Buxton and Bournemouth tolerate anything said to approach a nuisance? At the latter town it was considered a support to health, and a sight to be seen by its visitors. The destructor was erected within a stone's-throw of houses whose rents were from £400 to £500 per annum, and worked without inconvenience to the occupiers. In conclusion he advised them to induce their committees to select a site where there was ample space, not only for the furnaces with their probable extension, but have sufficient ground to enable the workmen to perform their duties with the best results, and due consideration for their comfort. Let them also provide good stores and ample water supply, and prevent as far as possible, sanguine inventors from experimenting with them, either at their own cost or the Corporation's, and thus miss the probable chance of failure.

WOOLHOPE NATURALISTS' FIELD CLUB.

At the last meeting, the Rev. M. G. Watkins, M.A., read a paper on "The Migration of Birds," in the course of which he said :—This subject is best divided into two parts ; first, the history of and the views which have been held on migration ; secondly, the phenomena of migration and the general laws connected with it.

The least observation showed men from the earliest times that certain birds arrived and departed at certain seasons. The first writer to take a scientific interest in migration, whose speculations indeed were not superseded for more than 2,000 years, was Aristotle. He notes the analogy between the migration of fish and of birds, and is the earliest writer to name the double migration of birds, from the autumnal cold into warmer regions, and from summer warmth again to colder countries. Cranes, he says, fly facing the wind, which is now found to be more or less the case with all birds. He has discernment enough to pronounce that the fable of their carrying a stone with them for ballast is untrue. Quails cannot fly with ease in showery weather, hence they utter their call to each other as they fly, being in difficulties. On their outward journey they have no leaders, but on their return they take with them the quail-mother (probably the landrail), the long-tongued bird (perhaps the greenshank), the night owl, and the ortalan. The latter calls to them through the night. Cranes, too, choose a leader, and rest all night on the ground during their migrations, with their heads under their wings, and standing on one leg in turns, while the leader, with eager neck, listens and looks out and gives notice in case of alarm.

The Roman Pliny, 300 years afterwards, is much more credulous. He repeats these stories of the crane. "Some birds," he states, "make voyages over sea and land to see strange countries." Quails settle at times in great numbers on sails and masts, thus bearing down the ships and sinking and drowning the sailors. They choose companions to go with them, especially the "glottis." "This bird," says Pliny, in his quaint fashion, "is very forward at the first setting-out (as being desirous to be a traveller, to see far countries and to change the aire), and the first daies journey he undertaketh with pleasure, but soone finding the tediousnesse and paines in flying, he repents that ever he enterprised the voiage. To go backe again without company he is ashamed, and to come lag behind he is as loth ; howbeit for that day he holdeth out so-so, and never goeth further ; for at the next resting-place that they come unto, he faire leaveth the company and staieth there, where lightly he meeteth with such another as himselfe, who the yere before was left behind. And thus they do from time to time, yere by yere."

The first author to examine bird migration with a scientific eye was undoubtedly Gilbert White, just a century ago. He gives lists of summer and winter migrants, with the times when the birds arrive or depart, shows that food supplies are not the only cause of migration, and that birds cross usually at the points which give the shortest sea-voyage. But his sight was clouded by the tenacity with which he clung to his belief in the hibernation of birds. Many theories have since his time been enunciated by Weissman, Palmen, and others, but the first requisite on which to found a safe judgment, abundance of varied observations on migration, was wanting. The influence of Darwinism, too, has rendered it almost necessary for his disciples to assume that not instinct, but experience, not indeed the experience of the individual but of the species, compelled and guided migration. Ten years ago, therefore, it might be said that our scientific horizon with respect to migration was almost where it was in the time of White of Selborne ; that is, our knowledge of the subject had practically not advanced for a century.

In 1879 a conviction had entered the minds of many bird students that without more accurate observations and abundance of them from all quarters of Great Britain, no definite conclusions respecting the phenomena of migration could be reached. A committee was in that year appointed by the British Association (which soon obtained the aid of the Trinity Board) to investigate and register the phenomena of migration round our coasts. The plan adopted was to issue circulars inviting lighthouse-keepers to note and forward to the committee any particulars of birds coming or going by day or night, and especially of any which accidentally killed themselves by striking against the lanterns. Sometimes as many as 200 birds in a night are killed on a lighthouse, chiefly land birds ; marine birds seem to have acquired more experience. Starlings strike in the greatest numbers, woodcocks usually one at a time. Many of the lighthouse men have now become expert in identifying birds, and enjoy registering them. At the close of the year the schedules are sent back to the committee, who then proceed to tabulate, and, if possible, draw conclusions from them. The annually published volumes containing these deductions are of deep interest to all lovers of birds.

Birds, as a rule, it is found, follow the coast-lines in their migrations. One common route is across the Straits of Gibraltar, thence along the western shores of the European continent. Another route leads by Malta and Sicily to the shores of Italy and thence by the Riviera. A third leads over the Alps into Austria and Germany. Birds come across to England either from the North Sea or by the shortest way across the Channel. In the former case they generally fly over and sometimes halt at the little island of Heligoland, and there some of the most unexpected captures have taken place, while careful watch has been kept upon all birds which pass over. In a favourable season the number of these is very great. A competent ornithologist, Herr Gätke, fortunately lives there, and science owes much to his observations. Almost all the birds of Europe and Northern Asia migrate more or less, and, says Mr. Seebohm, "we may lay it down as law, to which there is probably no exception, that every bird breeds in the coldest regions of its migrations." He too regards migration as "a fact in the history of birds of comparatively modern date." It has often been debated what is the true home of migratory birds, whether the country in which they breed or the land they adopt as their winter quarters. The preponderance of evidence is, Mr. Seebohm thinks, largely on the side of the former theory ; and he adds, "the cause of migration is want of food, not want of warmth. The feathers of a Siberian jay or a Lapp tit are proof against any cold." Yet the autumnal emigration from us depends partly on temperature, partly on the period when young birds are able to shift for themselves. Migration usually takes place at night, but larks have been seen on the Channel migrating by day. Heligoland is probably not a hundred acres in extent, and its resident birds do not appear to exceed a dozen species, but its value to migratory birds as a resting place is so great that 150,000 larks have been caught there in a single night.

"On the night between October 28th and 29th, 1882," Mr. Gätke remarks, "we have had a perfect storm of goldcrests, poor little souls, perching on the ledges of the window-panes of the lighthouse, preening their feathers in the glare of the lamps. On the 29th, all the island swarmed with them, filling the gardens and over all the cliffs—hundreds of thousands; by 9 a.m. most of them had passed on again" ("Migratory Report," 1882, p. 49). Birds when migrating dislike a favouring as much as an absolutely contrary wind, preferring a wind from the side. They appear to fly at a high elevation, and when they arrive at Heligoland to drop down as it were from the clouds. Mr. Seebohm supposes that they migrate by sight and not by instinct, but the gravest difficulties appear to me to beset the former theory. In the spring migration (of course I take for granted a knowledge of our spring and autumnal migrations) the adult males usually come first, then the adult females, next the birds of the year, then wounded or crippled birds. On their return various stragglers first come, then the young birds, and finally the old birds. "The conclusion I came to," says Mr. Seebohm, "was that desire to migrate was an hereditary impulse to which the descendants of migratory birds were subject in spring and autumn, and which has during the lapse of ages acquired a force almost, if not quite, as irresistible as the instinct to breed in spring." Here again allowance must be made for the prepossessions in the writer's mind. "Among true migratory birds," he continues, "it appears to be a general rule that the farther north a species goes to breed the farther south it goes to winter."

During the land migration, the same author thinks that birds travel slowly during unfavourable weather, and rest at night, but for a sea journey they wait for a favourable wind and then come over *en masse*. Mr. Cordeaux, a member of the Migration Committee, agrees with this. "In the Cheviots," he says, "I have observed for two years in succession that the streams of small migrants from Scotland follow those main valleys which run nearest north and south, sticking closely to the lowest levels, where the brushwood and bracken beds offer greater privacy and security than the bare fell sides. Birds also, when migrating, follow from choice low-lying tracks of land and river-courses in preference to elevated plateaus and the summit-line of mountain ranges" ("Migration Report," 1886, p. 52). When birds cross the German Ocean, if fine they fly at a great height; if wet and cloudy they keep but a little distance above the waves. There is doubtless much mortality in bad weather, even among the larger birds, during their migration. The Lincolnshire coast during a gale has been found strewn with the dead bodies of the hooded crow. When countries are over-crowded with birds some appear to migrate for good and all into distant lands. The curious irruptions of the sand grouse into England in 1863, and again in the present summer, appear to be migrations of this nature.

Migration, then, among British birds may be considered as of three kinds. First, the regular stream of birds which come here in spring to breed and which leave us again in autumn, and again that similar stream which appears in October and leaves in February or March; next, the continuous migration of our common birds, blackbirds, jays, etc.; and thirdly, exceptional immigrations, such as that of the sand grouse just named.

As for the continuous migration of common birds, it may be noticed that this movement has only been discovered of late years, and that the reports from the different lighthouses show constant examples of it. Thus a migration of the same kind of birds frequently occurs, but in opposite directions, across the North Sea. Crows, rooks, jackdaws, starlings, larks, sparrows, buntings, and finches, have been noticed there crossing each other. Indeed, Professor Newton says, "Hence we are led to the conclusion that every bird of the northern hemisphere is to a greater or less degree migratory in some part or other of its range." Mr. Cordeaux takes blackbirds as an example of this tendency, and says: "In the autumn, during September, the young of the year leave their summer quarters, and their place is shortly taken by others, likewise young birds, coming in October and November from districts which lie directly east or south-east of Great Britain. Should an English winter prove severe, or even partially so, our old birds will also leave, and in their place we have an influx of old blackbirds from the Continent, pushed forward from similar causes. In the spring the Continental visitors disappear, and our so-called resident blackbirds come back to their nesting quarters. As far as our knowledge extends the normal conditions of locality and climate over the whole area are such as do not necessitate a regular interchange of the members of their respective *avi-faunas*. There is apparently no reason why our rooks, starlings, skylarks, and blackbirds should not be able to winter in England just as well as abroad;" and he adds: "Such are the ordinary phenomena of migration; a movement which is as regular and persistent as the flow and ebb of the tide." And once more: "Practically such birds as the lark and the starling are migrating all the year round." The robin, too, seems almost always moving from woods to the vicinity of houses and back again, and even to far distant countries such as Africa.

With regard to the third kind of bird migration—that which is local, occasional, and exceptional—it must be remembered that it is only so because we do not as yet see the full purpose which thus stirs so many birds at once. Doubtless, want of food is one great cause, or abundance of food in an unusual locality. Thus in 1885 the abundance of Arctic ice brought down mollusca, entomostraca, etc., to more temperate seas, and so vast quantities of gulls were observed in the Firth of Forth feeding on them. Again, the sand grouse (*Syrrhaptes paradoxus*), which visited our shores this summer, "from the short time necessary for incubation," says Mr. Tegetmeier, "and the rapid growth of the young, increases so rapidly that it may have been compelled to seek new pastures and to extend its range. It could not traverse northward for climatic reasons; eastwards its range is limited by the Pacific, southward is the larger bird of the same genus (*S. Thibetanus*), and it therefore proceeded westward." Cold is another cause of abnormal migration. Birds are pushed on as it were by it from a bleaker into a more sheltered district. A large and unusual influx of ring-ousels appeared at Spurn Point, Yorkshire, in May this year, and at the time of writing an abnormal migration of crossbills (*Loxia curvirostra*) is taking place from Germany. Some have appeared on the coast of Holderness, in Yorkshire, and one was captured and kept on board the light-ship at the Spurn for a week before it escaped. In a letter to Mr. Cordeaux, dated July 1st, 1888, Mr. Gätke sends the following interesting notes of the occurrence of the crossbill on migration in Heligoland:—"Have you seen any crossbills (*Loxia curvirostra*)? We are swarming here with them. Since the 16th of June there have been flights from ten, twenty, fifty—and sometimes all the hawthorns in my garden you know so well are crammed with them. There must, during some days, have been hundreds dispersed amongst the foliage. When they are feeding they remain quite dumb, and only when taking wing the whole chorus begins, calling 'cüt, cüt, cüt.' I have just mounted an old male, almost as red all over as a male *Fringilla erythrinus*; a few with white bars have been reported but I have not seen one. They are of all shades, from lemon to orange scarlet, and almost carmine, but the greater number, as you may fancy, are grey birds, but not a single striped young one amongst them. These birds are rather out of date; they are not regular visitors to this island, years intervene without any being seen, and when they do appear it has almost invariably been in August, with boisterous north-westerly winds and rain; this year flight has been two months too early, and came with fine sunny weather. All are in excellent plumage—wings, tail, and all."

In conclusion, it may be noticed that what I have said refers merely to the phenomena of bird-migration. The motives in the little wanderers' minds are still, and are long likely to be, an inscrutable mystery. We can only affirm that they proceed from a divinely-planted impulse, an ἐνέργεια, which in truth must underlie both use and wont on long experience in directing these hidden irresistible journeys over wide continents and waste seas. How this instinct or impulse works is a proper question for investigation by naturalists. Thus Darwin supposes that migration is due to long habits, originally awakened by the need of a distant search for food. Mr. A. R. Wallace's view, however, holds that migration is one of the means of getting rid of the enormous surplus of bird population, as only a small number, he thinks, survives out of the vast crowds which seek to pass from one region to another. What this instinct is in itself is as fruitless a question as similar inquiries in human psychology. The more a lover of birds attempts to understand the motives which bids them change their skies or pass from the ken of man to the comparative obscurity of the woods, the more he is foiled. But the attempt to penetrate this great secret of bird life will assuredly fill him with ever-increasing wonder as he reflects on the resolution shown by even the feeblest birds in carrying out this law of their being—how such feathered atoms as the golden crested wren brave the rough nights and severe weather of the North Sea in October to reach our shores; how the sand martins, the smallest of the British swallows, do not scruple to commit their delicate forms at the same time to wastes of sea and leagues of land, in order to arrive at their winter homes.

Cheltenham Natural Science Society.—The annual meeting took place on October 4th, when the President, Mr. Francis Day, C.I.E., read the annual address, and the election of President and Council for the ensuing year took place. Mr. Day was again chosen President. Mr. Day, in his address, reviewed the work of the past session. At the conclusion of the business of the annual meeting the first regular meeting was held, when a paper was read by Dr. Drew on "Flight of Birds and Insects."

Liverpool Microscopical Society.—At the meeting held on October 5th, Mr. J. C. Thompson, F.L.S., F.R.M.S., was elected President for the year 1889. Mr. J. C. Thompson exhibited under the microscope and made some remarks upon some remarkable and little-known *Cladocera*, a genus of the *Crustacea*, which he had recently found at various depths in the Cumberland lakes. One of these—the *Leptodora hyalina*—is an exquisitely transparent creature about a quarter to half an inch in length, and has the appearance when alive of a minute fragile glass canoe rapidly beating its way through the water. He had found it in Grasmere, Easedale, and Thirlmere lakes, its presence in the latter possibly possessing some interest in the near future to Manchester water-drinkers. The other forms Mr. Thompson exhibited were *Bythostrephes cederstromis*, *Bosmina longirostris*, an animal not uncommon in London drinking-water, and *Hyalodaphnia kathlbergensis*, a most eccentric-looking microscopic crustacean, with an immense eye, surmounted by a long pointed head. An interesting discussion followed, in which the President, the Rev. H. H. Higgins, Dr. Carter, and others took part.

Penrith Literary and Scientific Society.—The annual meeting and *conversazione* in connection with this Society were held on October 4th, when there was a large attendance of members and others.

Bristol Naturalists' Society.—At the first meeting the Hon. Secretary showed a specimen of *Staphylea pinnata*, the bladder or bag nut, which he had seen growing in the neighbourhood. Dr. G. Munro Smith gave a demonstration of apparatus used in physiological research. He first said that one of his objects in giving the demonstration was to call attention to the fact that the Bristol Medical School possessed a laboratory and apparatus for physiological research, and he expressed a hope that Bristol would help generously in the contemplated increase of the medical school.

TOTEM CLANS AND STAR WORSHIP.

A Paper Read by Mr. George St. Clair, F.G.S., before the Anthropological Section of the British Association.

(*Continued from p.* 393.)

It has been stated already that the word "totem" appears to mean crest, mark, or sign; the Rev. Lorimer Fison says, a badge of fraternity. In Queen Charlotte Islands, the Huidas are universally tatooed, the design being in all cases the totem, executed in a conventional style. It is of practical use to prevent wrong marriages.

Next, it may be observed, that if the totem-crest has an astral origin, we need seek no other origin of the worship of the totem animal. Plutarch long ago suggested that the worship of animals may have arisen from the custom of representing them on standards.* He was not far wrong if the animals were figured on the standards, because they were star-gods. The worshipper was created by his god. Prof. Sayce finds that a common phrase in Assyrian texts is this: "The man the son of his god"; † and of these deities, one is represented as a fish, another as an antelope, etc. As a parallel to the phrase, "The man the son of his god," we have, in the Hebrew Scriptures, the Moabites called "sons and daughters of Chemosh" (Num. xxi. 29), and even Malachi calls a heathen woman the daughter of a strange god (Mal. ii. 11). Among the Arabs, the Kalb tribe consists

* Lubbock's "History of Civilisation," 252.
† Sayce's "Hibbert Lectures," 244, 284.

of the Beni Kalb, *i.e.*, sons of the dog.* In Peru, the Incas were descended from the sun, which was their god; and so, if the Indians of Peru, before the Incas, claimed descent from the fox, dog, llama, condor, eagle and puma, besides the serpent and several species of fish, it is no very violent supposition that these also were the names of celestial bodies; in fact, we are told on the best authority† that each of these species was supposed to have a representative or archetype in heaven. There were Greek houses descended from Zeus the eagle, and from other gods, while many of the gods had close association with animals, as Athena and the owl, Dionysus and the dolphin, Apollo and the mouse. I have no doubt that some of the gods of the Egyptians, such as the ram-headed Ammon, were zodiacal; and there is a passage in Plutarch which connects these gods with the military standards or crests.

Since then the totem animal was the representative of a stellar god, who was the progenitor and creator of all his worshippers, we can readily understand how the animal came to be reverenced, even to the degree of being worshipped.

It becomes a principle that the totem animal is not to be injured, much less killed and eaten. The Australian will not kill the kangaroo, emu, or black snake, which is his totem, lest it should be his own protector, being, in fact, in the form of his god, and an incarnation of the deity. In New Caledonia, when a child tries to kill a lizard, the men warn him to "beware of killing his own ancestor?" The Osages believe themselves to be descended from the beaver, and therefore will not kill that animal. Everywhere it is the same; a man does not eat the animal which gives name to his clan, does not clothe himself in its skin, and, if compelled by circumstances to kill it, asks pardon for the offence and purifies himself from the sacrilege. He will eat freely of the sacred animal of another clan, but the incarnation of his own particular god he would consider it a crime to injure. Thus, in ancient Egypt, at Apollinopolis, men hated crocodiles and never lost a chance of killing them, while the people of the Arsinoite nome dressed geese and fish for these sacred creatures, adorned them with necklaces and bracelets, and mummified them sumptuously when they died. The crocodile here takes the place of the python, the enemy of Apollo, and therefore it is hated by the men of Apollo's city; while every student of Greek mythology will allow that Apollo was a celestial god.

It is a very natural arrangement that totem clans should be found localised in nomes or districts; and it follows from this localisation that the special god of the clan becomes the chief god of the district, while other deities of the country are not altogether ignored. We start with a small community, all of whose members reverence all the gods of the Zodiac. We see them divide into twelve companies, which become totem clans, each especially associated with the worship of one deity out of the twelve, but they will retain for a long time a lingering regard for all the rest.

Chæremon and the wisest priests of Egypt quoted, in support of their own opinions, those of the oldest Egyptians, whom they understood to acknowledge as gods, only the sun, moon and planets, the stars of the Zodiac, and those decans which are subdivisions of each zodiacal sign into three. These, they said, were the sovereign arbiters of destiny, which their fathers had honoured by sacrifices, and to which they had erected images.‡ It was an ancient opinion that the division of Egypt into thirty-six nomes or provinces, was in imitation of these thirty-six decans, each of which had its protector. The heavenly guardians became the protecting deities of the Egyptian nomes, which took the names of the animals there revered,§ as the lion of Leontopolis, the crocodile of Crocodilopolis, the wolf in Lycopolis, etc., while some of the deities were worshipped universally. In some places triads of gods existed; for example, Amen, Mut, and Chonsu, composed a triad at Thebes; and this may possibly have arisen through there being three decans to the sign. The connection between the gods and the beasts has been a puzzle

* Journal of Philol., ix. 17, 80.
† Lubbock, who quotes Prescott, and Garcilaso de la Vega.
‡ Dupuis, "Origin of Religious Worship," 24.
§ Dupuis, quoted in S. Wake, 261; Frazer 12, 37.

to writers on Egyptian religion,* but I think this was its simple origin; the living animals were symbols of the stellar gods, and the constellations may perhaps have received their animal names from their connection with the seasons and months of the year. In each nome the worshippers refrained from eating their own sacred animal.

The tendency to separate clannish development, distinct forms of worship, and internecine religious wars, was sought to be met, as I conceive, by the strict enforcement of the rule that children should never belong to the same clan as their father. There were two ways of achieving this object, and it may be difficult to say which would answer best; one would be the Australian system of classes, in which *Ippai* and *Kapota*, for instance, being man and woman of one class, marry together, and pass their children over to the class of *Murri* and *Mata;* the other, which, in fact, is more prevalent, would be for a man to take his wife from outside the clan, and the children to be reckoned to the same clan as their mother. This view brings the Australian system of classes into such consistent relation with the more widely spread system of the gens, that I venture to think it favours the explanation I offer of the reason for exogamy; especially as the Australian system is generally supposed to present peculiar difficulty.

This rule of exogamous marriage would operate to bring into each local tribe an increasing number of women and children belonging to every other, and in ordinary times the tribes might regard themselves as one people. But all the time the wife had a different god from the husband, the children were of the gens and blood of their mother, and when a blood feud sprung up, the father was bound to be the enemy of his own children. The only safety for the children was to go to their mother's blood relations, and remain with the clan from which she had been drawn; and thus there would come about a local concentration of the clans, which largely neutralised the good effect of exogamy.

The views which I am putting forward receive remarkable confirmation from the doctrine of metempsychosis. The curious connection between the institution of totemism and the doctrine of the transmigration of souls, has been noticed by several writers, but their explanations of the connection are not satisfactory.

Opinions might be quoted, but I must hasten to state my own—which is this, that the soul of a deceased person goes beneath the horizon with the sun, performs the same journey as the sun, and therefore necessarily passes through the signs of the Zodiac in succession, and becomes identified with one animal form after another.

"The doctrine of transmigration," says Sir Gardner Wilkinson,† "is mentioned by Plutarch, Plato, and other ancient writers as the general belief among the Egyptians, and it was adopted by Pythagoras and his preceptor Pherecydes, as well as other philosophers of Greece. Opinions varied respecting it; and some maintained that the soul passed through different bodies till it returned again to the human shape, and that all events which had happened were destined to occur again after a certain period, in the identical order and manner as before. The same men were said to be born again, and to fulfil the same career; and the same causes were thought to produce the same effects, as stated by Virgil. This was termed κυκδος αναγκης, "the circle (or orbit) of necessity."

This language is clearly borrowed from astronomy; it points to the revolution of the heavens, and the periodical recurrence of the same phenomena. It is confirmed by what we are told by Maspero.‡ "In the evening the soul follows the bark of the Sun and its escort of luminary gods into a lower world bristling with ambuscades and perils. . . . At midnight began the upward journey towards the eastern regions of the world. . . . The tombs of the kings were constructed upon the model of the world of night. They had their passages, their doors, their vaulted halls, which plunged

* S. Lang, "Myth and Ritual," ii. 107.
† "Ancient Egyptians."
‡ G. Maspero's "Egyptian Archæology," translated by Amelia B. Edwards, p. 154.

down into the depths of the mountain." The soul thus following the sun, of course traverses those constellations which, with some nations, were the Ram, the Bull, etc., with others the Hawk, the Crow, etc.; and thus the curious anomaly is explained that the clansman who has to do with only one totem animal while he lives, may have to do with several in succession after death.

It appears to be a half-forgotten tradition of the ancient belief which lingers among the various barbarous tribes that still believe in transmigration. The soul passing through the zodiacal signs, one after another, would arrive at length at its own clan-sign or totem; and there, perhaps, it would hope to stay, and enjoy felicity with its god. This is apparently the latent essence of that article of faith among Indians, that as the clan sprang from the totem, so each clansman at death reassumes the totem form. Thus the Moquis, believing that the ancestors of the clans were respectively rattlesnakes, deer, bears, sand, water, tobacco, etc., think that at death each man, according to his clan, is changed into a rattlesnake, a deer, etc.

Amongst the Black Shoulder (Buffalo) clan of the Omahas a dying clansman was wrapped in a buffalo robe with the hair out, his face was painted with the clan mark, and his friends addressed him thus: "You are going to the animals (the buffaloes). You are going to rejoin your ancestors. You are going, or your four souls are going, to the four winds. Be strong."* Frazer quotes the Australian ceremony at initiation of pretending to recall a dead man to life by the utterance of his totem name. An old man lies down in a grave and is covered up lightly with earth; but at the mention of his totem name he starts up to life.

I anticipate an objection to the views of my paper, that the theory seems to require a greater knowledge of astronomy on the part of Australians and Red-men than they or their ancestors are likely ever to have possessed; and perhaps a degree of religious culture, from which we should have to suppose they had fallen.

We have already heard witnesses to the fact that the Australian blacks are better acquainted with the stars than the average Englishman. They appoint men to study and to teach; and they find the knowledge useful on their journeys. Moreover they have a mythology, in which the eagle-hawk, and the crow are constellations. The Australians, then, appear to be elevated enough for our purpose. It must be allowed that they no longer carry out the religious and military duties, the rotational performance of which I imagine to be at the root of their class and clan distinctions, and they probably cannot give any intelligible reason of their present divisions, and their rules about marriage, totem animals, etc. But then neither did the Greeks of two thousand years ago understand the origin and meaning of their own mythology, and there is not a civilised nation in the world which does not retain some customs which it cannot explain, and which has not, in some things, become degraded in practice and belief. Besides, on any theory, the orgin of totemism appears to be forgotten. We might expect at least some obscure tradition of its origin to remain; and if I am right, we do actually find as much as this, in the idea that the totem animal is the creator, that the archetype is in heaven, and that men go to their totem god after death.

The zodiacal origin of totemism—if it be a fact—goes far to account for the widespread character of the institution. Measures of self-defence would be adopted instinctively by all tribes. The heavens are spread before all peoples; the seasons succeed one another in all continents; the moon divides the year into months universally. Thus Australian natives and North American Indians might get started on the same path independently; and ancient Greeks and Egyptians may have gone through similar stages of development in the early ages. What has been common to them all was so much observation of the star groups as to connect their periodical rising with the habits of animals, etc., and some kind of public duty to be performed by sections of the community in rotation.

* "Schoolcraft," Ind. Tr. iv. 86; Dalton, "Ethnol. of Bengal," p. 280. Quoted in Frazer, 36; Morgan, 179.

If there be truth in my general view, the theory I offer of the origin of totemism may not only be acceptable as an explanation of facts and arrangements which have appeared mysterious, but will indicate the following fresh lines of inquiry.

(1) What are the names of the constellations among barbarous and savage tribes?

(2) What is it that has led the families of men in all parts of the world to connect the constellations with animal and other symbols? I fancy the explanation may be that, according to the country or district, the abundance of wolves or hares, or of rain, would be the prominent feature of the month; and the sign of their coming would be the rising of the group of stars which marked the month. Thus the constellation which signalised the coming of the wolves would soon be called the wolf constellation, and a fancied resemblance to a wolf be traced among its stars, though it required a lively imagination to find it. Then the band of watchers gets named after the constellation; and all the rest follows.

(3) If the true origin of totem clans be actually found in the division of the year into seasons and months, and the corresponding division of the heavens, we have a new instrument in our hands for investigating the origin and significance of the castes of India, the *γενος* in Greece, and the *gens* in Rome.

CORRESPONDENCE.

The Editor does not hold himself responsible for opinions expressed by his correspondents, nor can he take notice of anonymous communications. All letters must be accompanied by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

THE SPARROW.

Sir,—In reply to your correspondent "Aruspex," I will first say that I very much doubt if there are more sparrows in this country than other birds, but because they congregate where they can obtain food they are more conspicuous. I again repeat that "the sparrow is not so prolific as it is generally supposed to be," and I beg to offer "Aruspex" some figures for which I will vouch the accuracy. In the breeding season of 1887 I counted the young birds in 89 broods, and found 278 young birds only, or $3\frac{1}{8}$ to a brood. Again, if the sparrow is so numerous, how was it that out of 500 small birds massacred in two days whilst feeding at a corn stack, there were scarcely any sparrows amongst the slain, the carnage falling upon the buntings, several kinds of finches, and some starlings?

When "Aruspex" advocates the destruction of the sparrow to make room for the swallow, he must have forgotten that the swallow feeds only on flies and moths, which are the product of grubs and catterpillars, and it is from these pests that we receive the greatest damage; but if these are to be allowed to live and turn into food for swallows, woe to all our fruits and flowers!

I fear "Aruspex" cannot know what kind of bird the American robin (*Turdus migratorius*) is, or he would not have quoted from S. A. Forbes' writing. The American robin is a bird quite as large as our song thrush, and it appears to me to be absurd to draw any comparison between it and the sparrow.

Having had considerable opportunities of watching the habits of the sparrow, I must say that I have never seen or even heard of its molesting the swallow, although I know they will sometimes take possession of a martin's nest, and as for their driving away "other true insectivorous birds," it is all mythical. JOSEPH P. NUNN.

Royston, Oct. 13th, 1888.

SNAILS EATING STONE.—M. Bretenniers has found in Africa limestone rocks curiously perforated with cylindrical cavities, and in each there was a snail (*Limax*). M. Gaudry agrees that those holes are really the work of the mollusks. He has met with them a great many times on Mount Pelegrino, near Palermo.

RECENT INVENTIONS.

The following list has been compiled especially for the SCIENTIFIC NEWS *by Messrs.* W. P. THOMPSON *and* BOULT, *Patent Agents, of* 234, *High Holborn, London, W.C.; Newcastle Chambers, Angel Row, Nottingham; Ducie Buildings, Bank Street, Manchester; and* 6, *Lord Street, Liverpool.*

FOOD FOR CATTLE.—A food for cattle has been patented by M. J. A. F. Feuchères, Paris. For horses it consists of an admixture of sawdust or wood powder with leguminous plants and cereals, and for horned cattle and sheep it consists of an admixture of wood powder with oil-cake.

MUSIC.—A method of teaching music has been patented by Mr. A. Adamson. This system of teaching music consists in raising cards having marked on them the visible signs of the notes, by means of the movement of rods and levers from a portable hand key-board or key-board instrument placed in front of the teacher and facing the pupils.

ELECTRIC METER.—An electric meter has been patented by Mr. G. Forbes. This method of measuring electric currents is founded on the fact that an electric current passing through a conductor generates heat. This heat is applied to evaporate a liquid, and from the quantity of liquid so evaporated the quantity of electricity which has passed through the conductor is estimated.

DRAWING APPARATUS.—A drawing apparatus has been patented by Mr. H. Marle. It consists of a vertical blackboard ruled in squares of convenient size for displaying the contour of the model, and has an arrangement for supporting the model in front of the squares, consisting of an adjustable joint, projecting at right angles from the centre of the board, and having means to support the model.

FIRE EXTINGUISHER.—An apparatus for subduing or checking fires has been patented by Mr. T. R. Douse. The invention consists in the employment of a tank containing an alkali liquor and a small vessel containing an acid. When a fire occurs the small vessel is overturned automatically, and its contents mixing with the alkali forms carbonic acid gas, which is forced out from the tank into the building, which it fills and thus subdues the fire.

MARKING DEVICE.—A marking device for use in scoring at cricket has been patented by Mr. C. E. Clowes. This device consists of a small case resembling a watch-case, which may be carried in the pocket; this case contains dials and hands or indicators, moved by suitable train of wheels for showing upon the dials the scores or numbers. In the case are suitable projections which are pressed by the finger for the movement of the indicators. A gong may also be provided to be struck at certain intervals, to indicate the completion of an over.

VEHICLES.—An improvement in the means of communication between drivers and passengers in vehicles has been patented by Mr. J. Sax. This invention is applicable to cabs and the like, and provides an efficient means of communication independent of mechanical locking and releasing. The apparatus is operated solely by electricity, and the moving parts are by magnetic attraction maintained in the positions to which they are brought. The moving part is a disc having upon it such expressions as "Stop," "Left," "Right," and "Speak," or such like indications, which may be used as required.

WATCHES.—A compensating balance-wheel for watches and clocks has been patented by Mr. E. Golay. The invention consists in the combination of two alloys, which produces a non-magnetic and unoxidisable compensating balance-wheel, which produces perfect regulation. The interior ring of the balance-wheel is formed of an alloy composed of about 40 per cent. platinum, 35 per cent. copper, and 25 per cent. nickel; the external ring is formed of an alloy consisting of about 55 per cent. silver, 35 per cent. zinc, and 10 per cent. copper.

RAZORS.—Mr. W. S. Simpson has patented a razor sharpener. The object is to provide a sharpener whereby the blade is laid comparatively flat, and the edge sharpened with a long incline, thus producing a better cutting edge. Between two shoulders on a stem are arranged a couple of parallel surfaces, between which is formed a roughened surface as a sharpening medium, against which the flat side edge of the blade is brought into contact during a to and fro movement, the back of the blade bearing against the shoulder on either side as a guide.

PLANT SUPPORTS.—Mr. W. Hopwood has patented a plant support. This device is made of stout metal wire, bent to form a main leg constituting the vertical portion, while the upper end is curved horizontally in the shape of a semicircular arm. At the angle formed the wire is bent to form a circular eye, and at the end the wire forms a catch. The main leg is fixed in the ground to the required depth, as is also a similar appliance, the catch of the first one being inserted into the eye of the second, and the catch of the second into the eye of the first. Thus connected the two form a hoop, having two legs, and thus support the plant.

SAFES.—An improvement in safes or strong-rooms has been patented by Mr. D. R. Ratcliffe. The object is to protect them from being broken into by means of wedges applied at the angles or joints. Bars of angle metal are cut into lengths of the width, length, and height of the safe or strong-room. The angles of these bars fit together and form a cubical frame, the sides of which lap over each of the angles of the safe, and form a continuous metal covering, making the safe proof against the insertion of wedges. The sides of the safe may be flush with the inner sides of the angle bars, or they may have grooves into which the edges of the sides of the safe are inserted.

ARTIFICIAL MARBLE.—An improvement in producing inlaid designs in artificial marble has been patented by Messrs. J. B. Rottenstein and H. A. Cousins. Sufficient plastic material is placed in the proper position in a mould as will cover the design it is desired to produce. While still soft a templet of the design is placed thereon, and a cutter passed around the templet. When the material has partially set, the superfluous pieces are removed, leaving the designs alone in the mould. If the designs are to be bordered or shaded, the chosen material is filled in around them, and cut in the same manner, after which the ground is filled in, and the slab finished in the ordinary way.

SALES.

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SELECTED BOOKS.

Planetary and Stellar Studies, or Short Papers on the Planets, Stars, and Nebulæ. By J. Ellard Gore, F.R.A.S. London: Roper and Drowley.

The Building of the British Islands. A Study in Geographical Evolution. By A. J. Jukes-Browne, F.G.S., of the Geological Society of England and Wales. London: Bell and Co. Price 7s. 6d.

The Metallurgy of Gold. A Practical Treatise on the Metallurgical Treatment of Gold-bearing Ores, including the processes of Concentration and Chlorination, and the Assaying and Refining of Gold. By M. Eissler, formerly Assistant Assayer of the U.S. Mint, San Francisco. With ninety illustrations. London: Crosby Lockwood and Son. Price 7s. 6d.

A Text-Book of Physiology. By Michael Foster, M.A., M.D., LL.D., F.R.S., Professor of Physiology in the University of Cambridge, etc. With illustrations. Fifth and thoroughly revised edition. In three parts. Part I. comprising Book I., Blood—The Tissues of Movement—The Vascular Mechanism. London: Macmillan and Co. Price 10s. 6d.

A Dictionary of Technical and Trade Terms of Architectural Design and Building Construction. Being practical descriptions, with technical details of the different departments connected with the various subjects: with derivations of, and French and German equivalents. Price 5s. London: Ward, Lock and Co.

DIARY FOR NEXT WEEK.

Wednesday, Oct. 24.—Institution of Mechanical Engineers, 25, Great George Street, Westminster, at 7.30 p.m.—Discussion of papers on *Description of Emery's Testing Machine*, by Mr. Henry R. Towne, of Stamford, Connecticut, U.S.A. *Description of the Compound Steam Turbine and Turbo-Electric Generator*, by the Honourable Charles A. Parsons, of Gateshead.

Thursday, Oct. 25.—Institution of Mechanical Engineers, 25, Great George Street, Westminster, at 7.30 p.m.—*Description of the Rathmines and Rathgar Township Water Works*, by Mr. Arthur W. N. Tyrrell, of London; *Supplementary Paper on the use of Petroleum Refuse as Fuel in Locomotive Engines*, by Mr. Thomas Urquhart, Locomotive Superintendent, Grazi and Tsaritsin Railway, South East Russia.

METEOROLOGICAL RETURNS

for the ten weeks ending on Monday, Oct. 8th, 1888. Specially prepared for SCIENTIFIC NEWS from official reports.

	Mean Temperature.	Rainfall.	Duration of Sunshine.
Scotland, East	51·5 degs., being 2·7 degs. below average.	3·9 ins., being 3·6 ins. below average.	296 hrs., being 12 hrs. below average
England, N.E.	52·6 ,, ,, 3·0 ,, ,, ,,	4·1 ,, ,, 2·3 ,, ,, ,,	266 ,, ,, 19 ,, ,, ,,
England, East	54·8 ,, ,, 3·5 ,, ,, ,,	4·9 ,, ,, 1·0 ,, ,, ,,	329 ,, ,, 9 ,, ,, ,,
Midlands ...	53·8 ,, ,, 3·8 ,, ,, ,,	3·9 ,, ,, 3·0 ,, ,, ,,	317 ,, ,, 4 ,, ,, ,,
England, South	56·1 ,, ,, 2·7 ,, ,, ,,	4·4 ,, ,, 1·8 ,, ,, ,,	355 ,, ,, 7 ,, above ,,
Scotland, West	52·3 ,, ,, 2·4 ,, ,, ,,	6·1 ,, ,, 4·3 ,, ,, ,,	312 ,, ,, 2 ,, ,, ,,
England, N.W.	53·6 ,, ,, 3·5 ,, ,, ,,	5·8 ,, ,, 2·5 ,, ,, ,,	324 ,, ,, 14 ,, ,, ,,
England, S.W.	54·8 ,, ,, 3·0 ,, ,, ,,	6·1 ,, ,, 3·6 ,, ,, ,,	375 ,, ,, 15 ,, below ,,
Ireland, North	54·1 ,, ,, 2·7 ,, ,, ,,	6·3 ,, ,, 1·7 ,, ,, ,,	259 ,, ,, 6 ,, ,, ,,
Ireland, South	54·5 ,, ,, 2·5 ,, ,, ,,	4·7 ,, ,, 3·6 ,, ,, ,,	334 ,, ,, 11 ,, above ,,
The Kingdom...	53·8 ,, ,, 3·0 ,, ,, ,,	5·0 ,, ,, 2·7 ,, ,, ,,	316 ,, ,, 3 ,, below ,,

Scientific News

FOR GENERAL READERS.

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CONTENTS.

SCIENTIFIC TABLE TALK.

By W. Mattieu Williams, F.R.A.S., F.C.S.

Good work is being done in the direction of so-called "Technical Education," which should rather be called *technological* education, to distinguish it from the true technical education which is given in the workshop. But my object now is not to discuss mere words, but to make a suggestion that I know from experience to be important.

During some eight or nine years I was the teacher of experimental physics and chemistry in the Industrial Department of the then infant Birmingham and Midland Institute, and pioneer of penny lectures to workmen. These were delivered regularly every week during about nine months of each year.

This, of course, brought me in contact with the most intelligent artizans of a town in which is included a greater variety of industrial avocations in proportion to its population than any other in the world. The friendly relations that I succeeded in establishing with my pupils enabled me to trace the effect of my teaching.

One of the directly useful results was that it enabled them to shift their occupations with far greater facility than was possible to the mere mechanical mechanic.

To those who are not practically acquainted with the condition of the modern artizan, such shifting of occupation may appear very undesirable. "The rolling stone gathers no moss," "Jack of all trades, and master of none," etc., may be quoted, but a further knowledge of what is daily occurring in our workshops would refute these proverbs and show that a large proportion of our most skilful artizans must be crushed by the progress of applied science, if only able to follow the particular trade or branch of trade to which they were originally apprenticed.

The trades of such men are being continually superseded or modified by such progress. The French platers and water gilders have been extinguished by electroplating and gilding; puddlers nearly so by Bessemer and other mild steels; bell-hangers by pneumatic and electric bells; engravers by photo-etching; and so on with a multitude of others. In Birmingham the gun trade is curiously variable, according to the prevalence of peace or war. Many others fluctuate with fashion. Thus the Coventry ribbon trade was ruined, but Coventry rose again to the surface by grasping at the bicycle.

But it is only the intelligent artizan or capitalist that can thus adapt himself to the rapid changes effected by modern invention and caprice.

Besides these who are thus liable to be improved out of existence, there is another class who should all start in their industrial career with at least two well-defined trades at their command. I allude to out-of-doors workers, who are dependent on the weather, or can only work at certain seasons. Masons, bricklayers, slaters, house painters, paper-hangers, gardeners, and many others are regularly out of work during a considerable part of every year. Some have a second occupation. A few understand the winter demand at gas works, for example. Some do a little snow sweeping, coal hauling, attendance on skaters, road making, etc , during winter; but a large proportion—a majority, I fear, are idle and worse. A very few understand the arithmetic of average income, live accordingly during the prosperous seasons, and keep a reserve for winter; but the usual bank is the pawnshop, with its ruinous usury, and the squalor of departed clothing and household goods just when they are most needed.

The demoralising effect of this enforced idleness and spasmodic prosperity is incalculable.

The possibility and advantage of varied occupation is strikingly demonstrated by the Norwegian peasant. His primary business is agriculture, the tillage of his own estate. But his summer has only a duration of three, four, or five months, according to the widely varying latitudes of that narrow strip of mountainous country. During the winter his fields are deeply covered with snow, and his only farm-work consists in the feeding of his cattle and horses, and working the snow plough over the share of national highway which the government compels him to maintain.

But he spends a merry, hard-working winter nevertheless. Though poorer as regards money income than the English bricklayer, he is prosperous and proud. He knows not the meaning of a pawnbroker, nor ever dreams of receiving charity visits from Lady Bountiful, or winter blankets or any other pauperising patronage —would scorn the suggestion of any such degradation. There are no workhouses in poor Norway, nor no demand for them, nor no claimants for out-of-door relief.

The Norwegian peasant is a Jack of all trades and a master of every one. He builds his own house, which for solidity and usefulness puts our jerry villas to shame. He is wheelwright, cartwright, blacksmith, farrier, cooper, cabinet-maker, carpenter and joiner, not only building his own house, but making all its fittings and solid furniture with his own hands. Some are shoemakers also, and many are wood-carvers of considerable artistic ability, some carving the hard ivory of the walrus tooth besides. The domestic cooperage is admirable. Those whose land comes to the shores of the fjords or lakes or rivers are also boat and ship builders, and knitters of fishing nets. Most of the agricultural implements are home made.

The watchmaking industry of Switzerland originated in an intelligent effort to provide a supplementary winter occupation for the peasant proprietors of the Cantons of Neufchatel and Vaud. In other parts wood-carving and similar domestic industries have been similarly adopted, and even the factory hands adjourn for harvesting.

Referring to the correspondence on the fecundity of sparrows that has lately appeared in these columns, I may mention a fact. I occupy a very old house, with a pair of old-fashioned wooden sun-blinds (*jalousies*) to each window. These were painted during the last spring, the work proceeding very slowly. The first step was to pull out the old sparrows' nests that were built in most of them. Considerable delay occurred—fresh nests were built and eggs laid—further delay—more nests and more eggs—and so on until I counted no less than five successive nests in each of the two places that I specially observed. In each of the fifth I destroyed four young birds. These vermin not only ravage our crops, but also drive away the useful insectivorous birds and the interesting song birds.

Some doleful paragraphs have lately "gone the round" of the newspapers. They relate to the colliers' strike for an advance of 10 per cent. on their wages, and the effect this will have on the price of coals in the course of the severe winter which is approaching. (Every coming winter is predicted to be severe in October, and as we have one or two severe winters in a decade, the prophets are sometimes triumphant.) Londoners have curious notions concerning the cost of coal, and many will be surprised to learn that an addition of 10 per cent. on colliers' wages will add about 3d. per ton to the price of coal. Colliers are paid by the ton of coal brought to the surface and screened into the waggons, usually by long weight, 22 cwt. to the ton. The price varies with the difficulty of working, but 2s. 6d. per ton is a full average. This should be understood, as we are threatened with a conspiracy to rig the market, and the advance of colliers' wages will be made a pretext for extortion by the conspirators.

THE UNSEASONABLE COLD.—In the night of Tuesday, October 2nd, a temperature of 22° F., *i.e.*, ten degrees of frost, was registered at Finchley.

THE ANCIENT INHABITANTS OF THE CANARY ISLANDS.

A PAPER READ BY MR. J. HARRIS STONE, M.A., BEFORE THE ANTHROPOLOGICAL SECTION OF THE BRITISH ASSOCIATION.

(Continued from page 406.)

THERE is one undoubted fact about the women, which stands out with greater prominence than any other—they were beautiful, very beautiful. When we remember that this description of them is frequently given by Spaniards who were accustomed at home to beautiful women of their own nation, we can confidently say that the women of this extinct race must have been exceptionally lovely. The priestly scribes of Bethencourt's expedition say, "The inhabitants of Canaria are tall, and look upon themselves as noble. They are handsome and well-formed people. Their women are very beautiful." Of Lanzarote, "The inhabitants are a fine race. The women are beautiful and modest." The women of Gomera were also noticeable for their beauty. We are told how Peraza, one of the Spanish leaders, became enamoured of a handsome Gomera girl, but who eventually betrayed him to her countrymen on account of his immoralities. At the present day, when travelling in Gomera, we were struck with the unusual beauty of the peasant women, especially in the centre of the island, where I strongly suspect much of the blood of the ancient race still lingers, though mixed with Spanish. In Valle Hermosa, for instance, the girls have perfect oval faces, generally dark eyes and a wealth of dark hair, fresh and delicate complexions, small well-poised heads, and shapely necks. Their figures are tall and well moulded, and carried with stately yet easy natural grace.

The marriage customs seem to have been different in the various islands. The Herreños were monogamous, and appear to have had no distinctions of rank, with the exception of the king, so intermarried freely. Every man wedded the woman he liked best, provided he could get her consent, and it was customary for the man when he chose a wife to make a present of cattle to her father, according to his ability, as an acknowledgment for his goodwill in letting him have his daughter. In this island the women worshipped a female deity, and the men a male. The ancient Gomeros, according to Azurara, regarded their women almost as common property, but this remarkable statement is not confirmed by the other narratives, and is contrary to what is elsewhere said ot the homely, domestic, and general moral character of the people. We must remember, too, that Azurara's account of this island was written before it had been conquered, and therefore it is unlikely that his informants knew much about the social habits of the natives.

According to Cadamosto, in Tenerife each man might have as many wives as he liked, and the same custom apparently existed which in England is said to have given rise to the curious tenure Borough-English. In Lanzarote, and perhaps in Fuerteventura, polyandry existed, a woman having as many as three husbands. In the other islands monogamy was maintained by law. None of the ancient Canarios had more than one wife, or the wife more than one husband, and the curious eastern custom existed of fattening the bride, here set apart for thirty days, with large quantities of milk and gofio.

ORIGIN OF THE RACE.

Whence came this singular race, the ancient inhabitants of the Canary Islands? Many have been the answers. Naturally they have been referred to the lost ten tribes. They are Assyrians, some of those who built the Tower of Babel. They are Jews specially banished to these Atlantic Islands for the purpose of being converted to Christianity. They are exiles from Africa, banished thence by the Romans, who cut out their tongues for blaspheming their gods—an explanation given as late as 1519, by one Thomas Nicols, who lived for seven years in the islands some thirty years after the conquest, and which is singularly enough mentioned by the Bethencourt chaplains as a tradition of the origin of the Gomeros. "This country is inhabited by a tall people, who speak the most remarkable of all languages of these islands, and speak with their lips, as if they had no tongues; and they have a tradition that a great prince, for no fault of theirs, caused them to be banished and had their tongues cut out; and, judging by the way they speak, one could well believe it."

There can be no doubt that the ancient inhabitants were highly civilised. Their customs, their habits, their traits, their laws, all indicate a civilisation that could not have sprung from a savage race, but must have been the gradual growth of ages.

The generally accepted opinion is that the natives found here at the conquest came from the neighbouring coast of Africa, and that their language and customs have affinity with those of the Berbers and Arabs. We know from Pliny's account of the travels of Suetonius Paulinus that there was a tribe called Canarii inhabiting a forest beyond the Atlas Mountains, and it may be suggested that members of this tribe, being the principal colonists, possibly named the whole group, and that consequently the inhabitants of the other islands were, for some time, called by tribal names, many of which survive to the present day. Mrs. Stone, in her "Tenerife and its Six Satellites," goes carefully into this subject of the names. She says, "Various are the constructions put upon these names, and the old names and modern are mixed in a manner difficult to unravel. Majo, which is said to be the ancient name of the people of Fuerteventura, has been converted into Majorero by the Spaniards, who also try to explain that Majo comes from a 'shoe,' referring to the curious foot-coverings of the natives. This is a poor explanation, for the shoes are similar to those worn in other islands. It is more likely to be from Majorata, the supposed ancient name of the island. Conejo, in like manner, is explained as a Spanish word, the inhabitants of Lanzarote being now called Conejeros, because of the number of rabbits in the island. It seems curious, if this explanation be true, that the Palmeros had not this name, as rabbits are said to be so plentiful in Palma. Titre-roygatra, which was the ancient name of Lanzarote, certainly does not seem to have any connection with Conejo. The names belonging to Tenerife admit of a tribal origin. Palma has quite lost its name of Benahoare, or Benehoave, and the present race are called Palmeros. As to Gomera, no one attempts an explanation, unless it be that it comes from Gumero, or Gomerita, a tribe mentioned by Leo Africanus as inhabiting the

HEAD OF GUANCHE MUMMY.

mountains of Mauritania. Numberless are the definitions of Hierro, already mentioned; but whether it comes from Hera, or Hero, the son of Gomer, according to P. Maestro Sarmiento, or Haoaros, another tribe mentioned in conjunction with the Gumeros, by Leo Africanus, or Hiero, who was a tyrant of Syracuse during the first Punic war, or none of these, is a matter not yet decided. But the signification of the names of the islands, renamed by the Spaniards as they are now known, is equally difficult of elucidation. There are no more palms in Palma than elsewhere. Fuerteventura is the least likely of all the islands to be considered as worthy of its name, 'fuerte,' strong or fort, 'ventura,' chance, luck, or, as some say, 'Buena-ventura,' good fortune. Viera states that Canaria is undoubtedly a Latin name, and draws certain deductions therefrom. This, however, is scarcely an argument, as, whatever names the islands or their inhabitants possessed, they would be Latinised by the conquerors."

While yet the islands are comparatively little known, let me, without laying myself open to a charge of pedantry, ask the public to call the islands by their right names. There is no reason for spelling Tenerife with two ff's. It is a four syllable word—Ten-er-i-fe. The large, round island is either Gran Canaria, or Great Canary, and not Grand Canary, as the daily papers have already barbarously started to call it in their "mails" list, since the cable to that island was opened. Still worse, however, is the mongrel appellation which is sometimes seen, "Grand Canaria."

From personal observation in the islands, it is probable that they were peopled originally by Berbers, but most likely by more than one tribe of that people, and I have little doubt that originally they were connected with the ancient Egyptians. The leaves of the laurel were placed on the head of a Guanche king at his coronation, and were similar to the lotus on the head of Isis. The "colocase," whose leaves are represented in Guanche designs, also are associated with the gods of Egypt. But there is a more forcible resemblance. There are only three nations known to have embalmed—the Egyptians, the Peruvians, and the people we are talking about. Many savage and semi-savage nations dried their dead, or smoked them, but the ancient people of the Canary Islands embalmed. "A judicious and inquisitive man," who lived twenty years in Tenerife, both as a physician and merchant, about the early part of the seventeenth century, says distinctly:—"The corps are sewed up in goats' skins. with thongs of the same, in a very curious manner, particularly as to the seams, which are incomparably even and exact." The mummies are embalmed similarly to those of the lower class of Egyptians, the incision for extracting the entrails being done with the "tabona," which, as in Egypt, was a stone of hard basalt. Galindo says their process was as follows:—"First they carried the body to a cave and stretched it on a flat stone, where they opened it and took out the bowels; then, twice a day, they washed the porous parts of the body, viz., the arm-pits, behind the ears, the groin, between the fingers, and the neck, with cold water. After washing it sufficiently, they anointed those parts with sheep's butter, and sprinkled them with a powder made of the dust of decayed pine-trees and a sort of brushwood, which the Spaniards called Bressos, together with the powder of pumice-stone; then they let the body remain till it was perfectly dry, when the relations of the deceased came and swaddled it in sheep or goat skins dressed, girding all tight with long leather thongs . . . . there were particular persons set apart for this office of embalming, each sex performing it for those of their own."

From other sources we gather that dragon's blood was an ingredient in the process.

I know of no Guanche mummy in England. At the British Museum, Mrs. Stone tells me she made inquiries and was shown as Guanche a mummy which was obviously Peruvian. In the museum of Tacoronte and Santa Cruz in Tenerife, there are several. Fig. 8 shows the head of one of the mummies in the latter museum. One at Tacoronte is in a very perfect condition, still encased in leather as it was found, with strips of hide, about an inch wide, tied and knotted round it. At the top, over the head, the mummy is tied up just as a sack's mouth is fastened.

Both the Egyptians and this nation used caves in which to lay their dead. The ornamental designs which I have seen—a good example of which are the marks on the painted cave at Galdar—are more Egyptian in character than anything else. Now, singularly enough, the Berbers lived in caves very similar to those used in the Canary Islands both formerly and now. Sir J. D. Hooker and Mr. Ball mention that when penetrating a defile known as Ain Tarsil, in Morocco, 3,000 or 4,000 feet above the sea, they saw caves some fifty feet above them, in the sides of the cliff, which they considered to be natural cavities enlarged by man. "The most singular point about these dwellings is the fact that they are all near the top of the cliff, where the rock is nearly vertical in position, that cannot now be reached without a ladder or other artificial assistance." This description would apply *exactly* to many caves in the Canary Islands, numbers of which are yet unvisited, owing to their inaccessibility. Messrs. Hooker and Ball did not enter any of these caves. I venture to suggest that some of them will be found to contain mummies similar to those of the Canaries. If so, the missing link between the ancient inhabitants of the Canary Islands and the Egyptians will have been found. Many points of resemblance are also noticeable between ancient Canarian words which have come down to us and similar Berber ones.

But going still further back we have good evidence that this people constituted part of the white dolichocephhalic race * which once extended through the British Isles, France, Spain, Northern Africa, Palestine, and Syria. The people of this aboriginal race, according to Professor Sayce, were distinguishable on account of their height and size, "and down to the time of David the gigantic descendants of the Anakim were still pointed out in the cities of the Philistines," whose height was "like the height of the cedars, and he was strong as the oaks" (Amos ii. 9). To this day in Tenerife the common expression for a tall, well-proportioned man is, "He is a regular Guanche." This race was a white-skinned, fair-haired people, which Professor Sayce says was characterised by the slightly retreating forehead and the peculiar nose, features certainly characteristic of the ancient inhabitants of the Canary Islands. Blue eyes and light hair are still to be continually met with in the most out-of-the-way spots.

* Upon the platform during the reading of the paper the author produced a Guanche skull. This Dr. Garson there and then measured and pronounced to be clearly dolicho-cephalic. He had not before seen the skull, and it had never before been measured

THE LAST OF THE GUANCHES.

The last we hear of the Guanches as a separate people is in the year 1532—thirty-six after the conquest —when Spanish delegates went to Spain to ask for the Inquisition to exterminate the remainder of those who were living, or rather merely existing in the inmost mountain recesses, and it is doubtful whether any pure-blooded survivor of the race now exist, for during my travels through the seven islands I came across none, though a sharp look out was kept. But it is very probable that in the natives now on the islands there is much of the old blood. During those thirty-six years, between the conquest and the advent of the dreaded Inquisition, there must have been much intermarrying between the two nations. The women of the ancient race were remarkable for loveliness; the Spaniards have never been pre-eminent for morality. An amalgamation of the two races has taken place. This admixture of Guanche blood in the islands to-day is evident from many plainly visible signs. The general character of the islanders struck me as being much softer, more simple, and more generous than that of the Peninsular Spaniards. There is a remarkable absence of bigotry and religious intolerance, and the peasants are imbued with a refreshing spirit of independence and love of liberty. That they have obtained from tariff-loving Spain the concession of free ports, is an example of their persistency and enterprise. Bethencourt found the Majereros "of large stature, powerful, and firmly attached to their form of government, very tall and difficult to take alive." Glas in his day noticed too that the natives of Lanzerote and Fuerteventura were of a noticeably large stature, and in my travels in those islands I observed the same. There is evidently more of the ancient blood in Hierro than in Tenerife. The old inhabitants of Palma were "a fine and tall people" and so they are to-day. As in the days of the Spanish conquerors, so now we found the Palmeros remarkable for their vivacity and wit, and some at any rate, of the quaint Palma costumes are very probably direct descendants of costumes worn by the ancient people.

The old inhabitants of Gran Canaria "are tall, and look upon themselves as noble. They are a handsome and well formed people. Their women are very beauful." A description generally applicable to the present inhabitants to-day. In this island it is recorded that the Spaniards slew a giant nine feet high.

The Conejeros are now, as they were before the conquest, "of a humane, social and cheerful disposition, very fond of singing and dancing." Many of the dances to be met with in the various islands are doubtless of Guanche origin.

The great inter-insular jealousy now existing between the islands reminds us very forcibly of the old days, and is perhaps a survival of the old feeling when there was no inter-communication among the islands, and when the natives of one island eagerly fought those of another when landed there by the Spaniards.

Beasts of burden were first introduced into the group by the Spaniards. Before that time all baggage must have been carried by men, probably on their heads. The pronounced development of the roughnesses and angularities for the attachment of the neck muscles, which I have repeatedly noticed on Guanche skulls, is confirmatory of this view. In the little-known island of Gomera the natives preferred to carry my portmanteau on their heads to trusting it to the baggage mule as in the other western islands, and this, too, for miles over very rough and laborious country.

A curious survival is the antipathy to blood-shedding. Butchers are looked upon as the lowest class of the com-

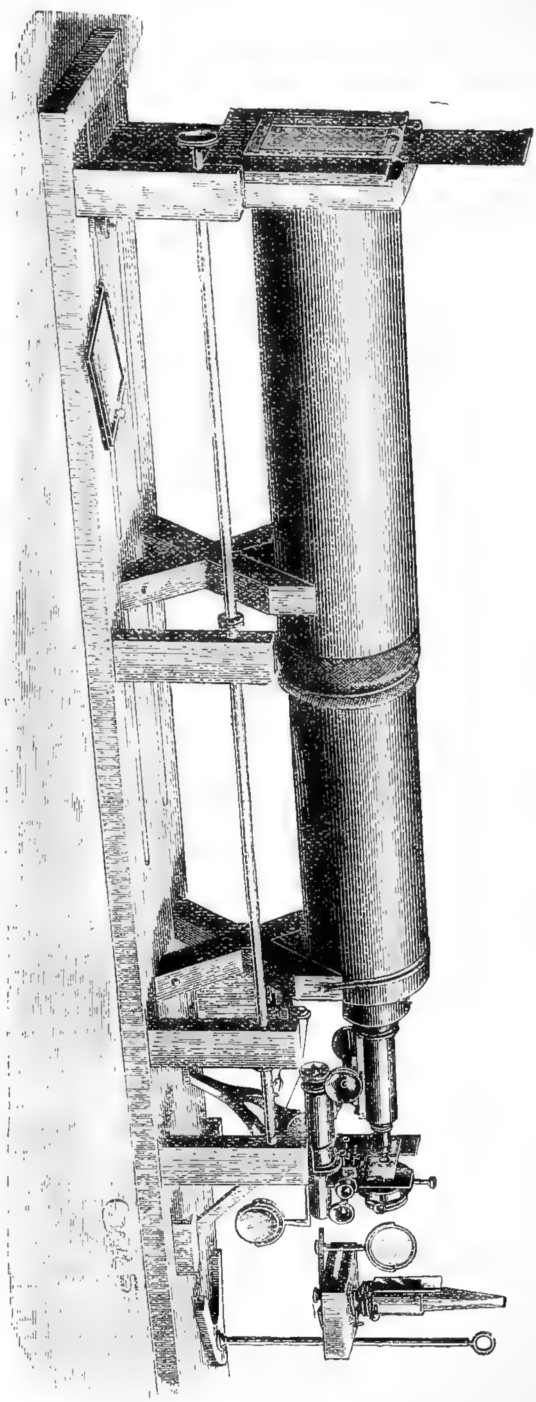


FIG. 6. (*See next page.*)

munity. Even the very criminals object to mix with them in prison, so that if convicted of misdemeanours they are whipped and not imprisoned. This horror of butchers, which is specially noticeable in Gran Canaria, dates from the customs of the *Antiguos Canarios*. Azürara says: "They held it an abomination to kill animals, and employed Christian captives as butchers when they could get them." And again, "Instead of killing their captives they thought it sufficient punishment to make them butcher their goats and skin them, and cut them up, an occupation which they looked upon as the most degrading that a man could be put to." Galindo states that it was made unlawful for the butchers even to keep company with any but those of their own profession; they were, in fact, treated just as lepers were by the Jews.

The ancient Canarians "showed remarkable faithfulness and honesty, for if one of them receives anything good to eat, before tasting it he divided it into portions, which he shared with the rest." This is a custom which we noticed in the other islands as well as in the Canaria.

Caves were regularly used by the ancient people, and to this day there are several inhabited troglodyte villages and separate cave dwellings, though now, as formerly, the natives excel in the art of dry-stone building.

The lancia, or leaping pole, was the usual means of rapid locomotion, and it is still used—particularly in Palma—by the natives with great expertness, the rapidity with which a Palmero will bound down a wild mountain side being most surprising. The natives used to catch fish in the night time by making a blaze on the water with torches of pine wood, and I have been out fishing with a man at night who employed identically the same process, doubtless in much the same manner as did his Guanche forefathers.

The modern rough pottery made in the islands closely resembles the old, so far as markings and shapes are concerned, but differs in not being so good in quality.

The general use of "gofio" is a most prevalent and noticeable survival from the days of the ancient inhabitants. Even the name of the food, the method of eating it, and kneading it in a gofio-bag made from a kid-skin drawn off whole, being the same. As in the old days, so now, it is the staple article of food.

A peculiarity in Canaria deserves record, as through the ancient Canarians it may have come down from the ancient Egyptians. I allude to a curious and emphatic way of saying "no" without speaking, by looking at the interrogator and rapidly moving the forefinger in front of and across the face.

A method of laying out the dead by placing one hand across the breast and the other along the side with the fingers turned out, is exactly the same arrangement as is seen in some of the mummies.

A Hint for Future Travellers.

Since we visited these island a tide of visitors has set in that direction, and future travellers may reasonably be asked to pay particular attention to, and to record, any other traits and habits of the peasants which strike them as being inherited from the old race; to explore caves, and to look out for their presence even in what are now inaccessible places, and if any mummies are found, to see that they are not treated as was that which was presented to the College of Surgeons.

Much remains to be done by original research in the islands; and important additions to our knowledge about this extinct people may be expected from the practical observations of travellers.

The Guanches have gone the way of the Dodo and the Mammoth—too gentle, unresisting, and antiquated to combat modern civilisation; and like them are now only visibly represented by specimens in museums. If I have imbued some of these dry remains with the elements of life, my purpose is served—to awaken interest means eventually to advance knowledge. I hope future travellers will be able to tell you much more about the Guanches than it has been possible for me to do.

Note.—The title to fig. 5 (p. 405) should read, "Two Pieces of Guanche Pottery, and Two Gofio-mills."

SOME PHOTO-MICROGRAPHIC APPARATUS.

(Continued from p. 403.)

In fig. 6 is shown a form of photo-micrographic camera, designed by Mr. E. M. Nelson in conjunction with Mr. C. L. Curteis, and made by Mr. C. Baker, of High Holborn.

The camera has been specially designed for use with Professor Abbé's new three-power projection eye-piece, specially corrected for use with Zeiss' apochromatic objectives, and the camera is so arranged that when closed the magnification given by the three-power projection eye-piece is equal to nearly five times the initial magnifying power of the objective used, or an equivalent to the power obtained with an "A" eye-piece, whilst, when fully extended, it gives ten times the initial magnifying power of the object-glass, or the equivalent magnification produced by the use of a "C" eye-piece, a degree of magnification which it is not advisable to exceed.

The accompanying woodcut shows very clearly the whole arrangement. The camera is constructed to take a plate $4\frac{1}{4}$ by $3\frac{1}{4}$, and consists of two cardboard tubes, the one sliding into the other, like the tubes of a telescope, the joint between the tubes being made light-tight by means of a velvet flap, fastened down by an india-rubber band. The light excluding cap is made of cardboard covered with leather, this being found to be quite as efficient as, and not so heavy as, a brass fitting. The outer cardboard tube is fixed to a vertical standard which can be secured to the base-board, at any point within its range, by means of clamp screws working through slots. The focussing screen slides into the back of this standard, which is provided with suitable grooves to receive it.

The focussing arrangements are essentially similar to those previously described.

Archæological Discovery.—An archæological discovery of great interest has been made in the tidal river Hamble, near Botley, Hants. A boathouse is being built at the point of the junction of the Curdridge Creek with the river, some little distance above the spot where there is a still existing wreck of a Danish man-of-war. In removing the mud and alluvial soil to make sufficient waterway, something hard was encountered, which on being carefully uncovered proved to be a portion of a possibly pre-historic canoe—certainly pre-Roman. It is a few feet higher up the river than the old Roman hardway or landing place, and was evidently sunk close to the shore. It is about 12 feet long by $2\frac{1}{2}$ feet wide, beautifully carved, and in a fairly good state of preservation. Some question of ownership is likely to arise, as it was discovered below high-water mark. The adjacent land teems with fragmentary specimens of Roman pottery, bricks, etc., and it is anticipated that the explorations will lead to further discoveries.

General Notes.

Temperature at Cairo. — The average maximum temperature for the week ending July 19th was $106\frac{1}{2}$ degs. F., and the extreme heat $114\frac{1}{2}$ degs. The lowest temperature registered was $72\frac{1}{4}$ degs.

Effects of Unwholesome Water.—According to a medical contemporary, the death-rate at Cairo is now 73 per 1,000. This mortality is ascribed to the polluted water of the Nile being used for drinking.

The Prevention of Sea-Sickness.—According to the *Bulletin Medical*, antipyrine has no effect upon sea-sickness. The *New York Medical Record* proposes oxalate of cerium, given in 15-grain doses every two hours. *Science* recommends that the projecting region behind the ears should be rubbed vigorously with the fingers.

Exploration in Morocco. — We learn that Mr. Joseph Thomson is at Tangier on his way home from Morocco, having been offered an important mission. Mr. Harold Crichton Browne, who is at Rabat, will carry out alone the remainder of the Morocco expedition as originally planned. He proceeds at once to Mequinez and Fez.

Physiological Instruction in the United States.—It appears (*Science*) that in twenty-five out of the thirty-eight States, and further, in all the territories and the district of Columbia, "instruction in physiology and hygiene, with special reference to the effects of stimulants and narcotics, is made compulsory by statute on all pupils in some part of their school life."

Colour-Hearing.—Mr. J. A. Maloney, after describing in the *New York Medical Journal* and in *Science* some interesting experiments on the conduction of sound-vibrations by the bones of the skull, asks:—"May not colour-hearing, in view of the readiness with which the sphenoid bone takes up and delivers vibrations, be due to mechanical stimulation of the optic nerve by the impingement upon it of the sphenoid bone in its passage through the optic foramen?"

A Novel Falsification of Food.—M. van Hamel Roos (*Cosmos*) has recently detected at Amsterdam 30 per cent. of marble dust in ground rice imported from Italy. In Haute Vienne, one of the most extensive millers of the district has been found to have mixed carbonate of lead with his flour. This fraud gives the flour a fine appearance, renders it whiter, and enables the dealer to pass off inferior qualities. The consumer is, of course, liable to the miseries of lead-poisoning.

Dangerous Cookery.—According to the *Medical Press*, a lady at Tournai treated her guests to a very tasty dish of *beignets aux fleurs d'acacias*, the prescription for which she had taken from the family cookery-book. Eleven persons partook of the dish, and soon after all of them showed symptoms of poisoning—vomiting, cerebral excitement, dilatation of the pupils, etc. The supposed "acacia flowers" were flowers of *Cytisus Adami*, a variety of the common laburnum, every part of which is poisonous.

The Green Colour of the Sea.—According to Pouchet (*Comptes Rendus*), the green colour of the sea in many parts is due to the presence of numerous diatoms, radiolaria, etc. The microscopic organisms contain *diatomine*, a yellowish-brown colouring matter, and this yellow, conjointly with the natural blue of the water, constitutes the green colour observed. Pouchet was led to this view by the fact that *Pelagia noctiluca*, which has a yellow colour, appears green when immersed in the sea.

The Cork Industry in Spain.—The British Consul at Barcelona, in a report just published, states that in some places the cork trees have been suffering from the invasion of a pest which threatened to destroy them. A voracious caterpillar appeared by millions in the cork forests, and in a very short time stripped the trees of all the leaves from the tips of the branches to the trunks. These caterpillars are now in their turn attacked and devoured by another insect, a species of beetle of a dark-green colour. Another insect in the form of a crab (*cangrejo*) pursues the caterpillars and destroys them. Moreover, when the caterpillar has passed through its metamorphosis and the butterflies have deposited their eggs, another insect, until now unknown, attacks and pierces the bags containing the eggs and destroys them. It is hoped that by means of these three agencies the complete extinction of the destructive caterpillars may be accomplished.

The Electrical and Allied Trades.—On Monday last a meeting was held at the offices of the London Chamber of Commerce, Eastcheap, for the purpose of completing the organisation of the electrical trade section of the Chamber, with the object of dealing effectively with questions of general interest relating to the trade. Mr. W. Crompton was voted to the chair. The organising committee, appointed at the meeting on the 27th of July last, brought up a report, in which they recommended that a working or executive committee—elected annually by the general body of the trade—should be charged with the ordinary business of the section, and that in the first instance it should consist of thirty-three members, to be increased to forty-eight at the first annual meeting, if the membership then obtained should warrant a larger representation. With a view to an equitable representation on the working committee of the various branches of the electrical trade, the organizing committee recommended the division of the working committee into the following subsections:—Telegraph companies, 5 members; telephone companies, 3 members; electrical supply companies, 6 members; electrical manufacturers and contractors, 13 members; consulting electrical engineers, 4 members; and "general," two members. On the motion of Mr. Reeves, seconded by Mr. Brown Martin, the report was adopted; and on the motion of Mr. Rawson, the working committee were authorised to elect their chairman and vice-chairman, if they wished to do so, from outside their own body. The election by ballot of the working committee was then proceeded with.

The Invention of the Microscope.—This subject has recently been discussed at a meeting of the Paris Academy of Sciences. By general consent the invention of the compound microscope is ascribed to Drebbel, unless he derived his knowledge of the instrument from Jansen. M. Govi considers that the true inventor was Galileo. From 1610, that is eleven years before the invention of Drebbel, the Italian savant is supposed to have used his telescope for viewing very small objects, which he then saw highly magnified. In 1614, Dupont, Lord of Tarbes, relates among the incidents of a journey in Italy, that Galileo had thus given to flies the apparent bulk of lambs, and ascertained the presence of innumerable hairs on their bodies and of pointed claws on their feet. When the Dutch invention penetrated into Italy in 1624, Galileo attempted a reclamation of priority, but soon finding that his attempts were overlooked abroad, he preserved in future silence on this great question, despite the distinctness of the facts established by M. Govi. M. Emile Blanchard persists in thinking that the true inventor of the microscope is not easy to discover.

Restoring the Colour of Faded Flowers.—In spite of all care taken, it often happens that flowers lose their odour during drying. We quote, therefore, the following two processes, given by M. Capus, in *Le Naturaliste*, which it is asserted will revive the colour to a certain extent. Red flowers especially, which have turned blue or violet, may be restored to their primitive colour in the following way:—A slip of white blotting paper is steeped in very dilute nitric acid (1 part acid to 10 or 12 of water). The flower is laid on this slip, and the whole is enclosed between several folds of dry paper and submitted to a moderate pressure for some seconds. At the end of this time the original colour will generally be found to have re-appeared. All flowers do not require the same pressure nor the same strength of acid. If a flower is too pale after the operation, it is because the acid is too weak or the pressure too strong. If the green leaves of the plant come in contact with the acid they lose their colour. Dried plants may also be divided into small lots and placed in a box in which sulphur is burnt. We look upon this latter process with considerable suspicion, on account of the well-known bleaching action of sulphurous acid.

The Public Health.—The Registrar-General's return for the week which ended on Saturday, October 13th, states that the deaths registered in 28 great towns of England and Wales corresponded to an annual rate of 21·0 per 1,000 of their aggregate population. The six healthiest towns were Birmingham, Brighton, Bristol, Derby, London, and Wolverhampton. The highest annual death-rate, measured by last week's mortality, were:—From measles, 1·1 in Huddersfield; from scarlet fever, 3·1 in Blackburn; from whooping-cough, 1·1 in Derby and in Manchester, 2·4 in Cardiff, and 2·9 in Huddersfield; from "fever," 1·2 in Salford; and from diarrhœa, 2·8 in Norwich, 3·2 in Wolverhampton, 3·4 in Portsmouth, and 3·5 in Preston. The 45 deaths from diphtheria in the 28 towns included 26 in London, 5 in Manchester, and 3 in Newcastle-upon-Tyne. The only death from small-pox in the 28 towns occurred in Hull. In London 2,588 births and 1,536 deaths were registered. Allowing for increase of population, the births were 122 below, while the deaths exceeded by 13, the average numbers in the corresponding weeks of the last ten years. The annual death-rate per 1,000 from all causes, which had been 15·8, 16·0, and 16·5 in the three preceding weeks, further rose last week to 18·7. In Greater London 3,438 births and 1,896 deaths were registered, corresponding to annual rates of 32·4 and 17·9 per 1,000 of the estimated population. In the Outer Ring 14 deaths from diarrhœa, 9 from measles, 8 from diphtheria, and 6 from scarlet fever were registered. Of the fatal cases of diphtheria, 3 occurred in Croydon, and 2 in Walthamstow sub-districts. The 6 deaths from scarlet-fever included 3 in West Ham sub-district.

Globe Lightning.—M. Reimann has recently published some interesting observations on globe lightnings witnessed at Hirschberg, in Silesia, during the storms of the 19th and 29th of April, 1888. *La Nature* gives an abstract of the phenomena from the *Bulletin de la Société Météorologique de France*. Two such globes were seen during the former storm. A woman and her son were at two different windows in the third storey of their house in the Wilhelmstrasse and the Inspectorstrasse. A yellow ball of fire, of the size of a skittle-ball, appeared advancing slowly on the telegraph wires, with a slight noise like that of a flag shaken by the wind. It descended in the middle of a square covered with grass; it then rose up and moved forward, flying higher and more rapidly than before, and passing over the houses of the Inspectorstrasse in a S.S.W. direction. The second ball was seen by another woman, about 4 p.m., from a window looking to the east. The globe of yellow fire advanced very rapidly from the Franzstrasse towards the window, at a distance of 20 to 25 metres, moving from south to north. It passed over the Bahnhofstrasse, and rose upon the roof of a house provided with a lightning conductor, leaving no traces. Its size was about that of a child's head. It was followed by a series of smaller globes like billiard-balls. No sound was heard. The storm of April 29th was extremely violent, and several remarkable flashes were observed. A woman saw a large brilliant ball fall perpendicularly from a cloud over Hirschberg, and break up into several fragments, which disappeared in the air. Another globe-discharge in the storm was very similar to that of the 19th. It was observed by the gardener of the Gymnasium, who was in an arbour of the garden, and by a girl from a window in the Inspectorstrasse, at a distance of 50 to 60 metres from the Gymnasium. The globe traversed a space of about 100 metres. Said the gardener:—"It was a globe of reddish fire, which advanced suddenly from the roof of the Gymnasium with a hissing noise, and burst over the trees of the garden without an explosion. The fragments descended to the left and the right, and disappeared in the air, leaving no traces." The girl saw suddenly, to her right hand, on the house opposite, a ball of fire which advanced rapidly towards the corner of the Gymnasium and rose to the angle of the roof, where it burst without noise. It was about the size of a child's head. The author relates another observation communicated by Herr Rudeck, of Wigandsthal, near Freiburg. On May 14th, during a storm which lasted four hours, about 5 p.m. fifteen persons saw a ball of fire of about the size of a soup-plate, and of a dazzling whiteness, which appeared over Rudeck's house, illuminating the house and the court. It descended perpendicularly, and rested on a tree in the court, at 1½ metres from the house. Several observers saw lightning issuing from the branches and moving towards the lightning conductor. At the same moment two servant girls rushed into Herr Rudeck's sitting-room screaming that there was a ball of fire in the kitchen. It left behind no traces. The phenomenon was accompanied by a peal of thunder.

MARS AND ITS "CANALS."

DURING the last few years the attention of astronomers has been increasingly drawn to certain curious phenomena observed in the planet Mars. These appearances are of the higher scientific value since two only of the heavenly bodies, Mars and Venus, are likely to throw fresh light on the important question in how far any of the other planets may resemble our earth? Mercury is too small, too distant, and too much lost in the sun's rays to afford us any evidence. The exterior planets Jupiter, Saturn, and the rest seem to belong to a totally different class of bodies.

Of the only two planets which remain, Mars offers us the better facilities for observation. Though smaller than Venus, and at a greater distance from the earth, he is at times seen "full," whilst Venus never turns to us more than a portion of her illuminated disc, like the moon about the first quarter. Hence the importance of a thorough scrutiny of Mars. A long time ago it was discovered that around the poles of this planet there exist whitish "caps," which increase or decrease periodically with the season of the year, and which at once remind us of the snowy regions investing our north and south poles.

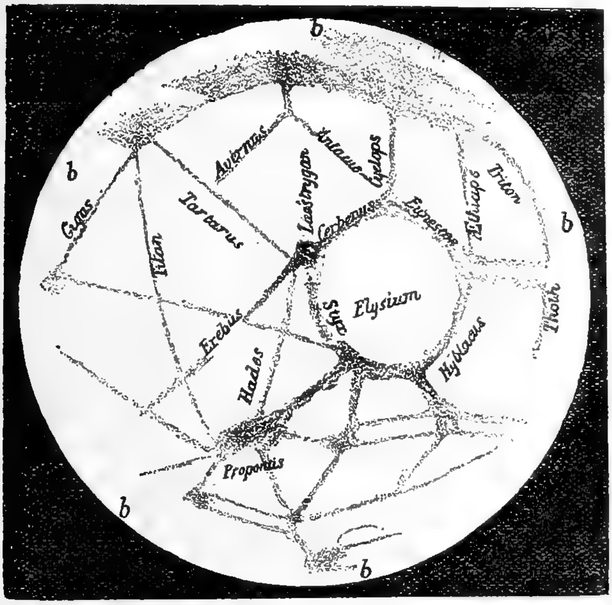
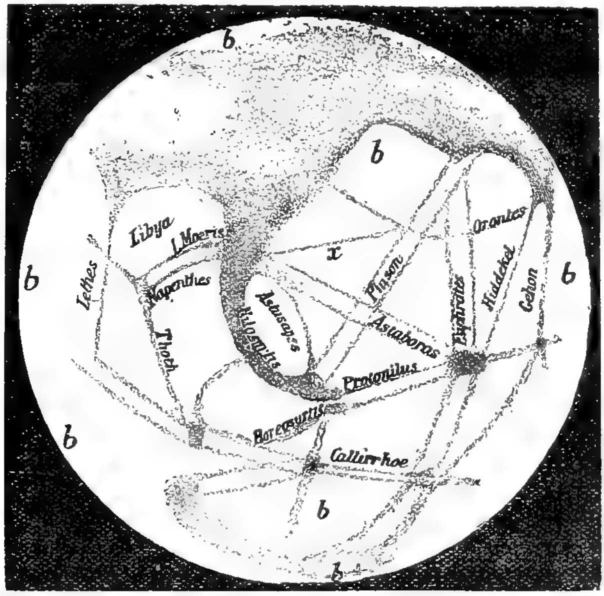


FIG. 1.—MARS AS IT APPEARED ON THE 8TH, 9TH, AND 10TH OF MAY, 1888. (AFTER SCHIAPARELLI.)
b. White spaces.



MARS AS IT APPEARED ON THE 2ND, 4TH, AND 6TH OF JUNE, 1888. (AFTER SCHIAPARELLI.)
b. White spaces.

Further, there appear on the disc of the planet spots fairly permanent in their outline, and differing in their colour. There are sombre regions which are supposed to be seas, and there are also brighter tracts of a reddish colour which astronomers regard as continents. The land and water, if such they be, as we may provisionally assume, differ both in relative proportion and in configuration from those of our earth. Our ocean occupies at least two-thirds of the earth's surface, and our land is mainly grouped in two large masses, beginning near the North Pole and extending southwards. On Mars the proportions of land and water are nearly equal, and we find, as the late Mr. Proctor puts it, a great number of long and narrow necks of land and of seas, shaped like the neck of a bottle.

We have been thus obliged to premise facts, doubtless well known to the majority of our readers, for the better comprehension of what is to follow.

Such was the state of our knowledge of the surface of Mars when in 1877 Professor Schiaparelli, an Italian astronomer, discovered what are now known as the "canals." The continents of Mars are intersected with lines, most frequently straight, sometimes fine, very dark and distinctly traced, sometimes broader and misty, sometimes black, sometimes grey, blueish, or reddish. These lines seem to place the seas in communication with each other, and they cross and re-cross each other, forming at certain points knots which the telescope has not succeeded in disentangling. In some regions these lines —canals or whatever they may be—display slight windings resembling those of our rivers, though in a much less pronounced degree.

A general notion of the aspect presented by Mars, as seen with a powerful telescope, may be formed by an examination of figure 1, for which we are indebted to our contemporary *Ciel et Terre.*

Strange to say, this discovery of Schiaparelli was received at first with almost as much incredulity as was bestowed upon Galileo's early observations of the phases of Venus, of the moons of Jupiter, or of mountains in the moon. The canals were pronounced by some to be mere illusions due to defects of the telescope or to atmospheric peculiarities. But when other observers confirmed substantially Schiaparelli's results, using other instruments, this sceptical attitude was, of necessity, abandoned.

The next step in the study of a phenomenon, which has been rightly called mysterious, was again taken by Professor Schiaparelli in 1881-82. At that time Mars was in opposition, its entire illuminated disc being turned towards us. Utilising this favourable circumstance, the Italian astronomer observed that nearly all the canals appeared double. This phenomenon, spoken of technically as their *gemination*, requires to be precisely described. Alongside one of the old canals, or at least of one of the canals as they had been previously seen, there appeared a new one (*i.e.*, one not seen before), in most cases strictly parallel to the former, and terminating not at the same points, as if the old canal had been merely resolved into two components by the use of a more powerful instrument, but leading to neighbouring points, as if a new canal had been dug parallel to the former. The totality of these parallel or twin lines, intersecting each other too in all directions, seemed like an inextricable net. A superficial examination might lead to the conclusion that the original state of the surface of Mars had been entirely overturned. Such, however, is not the case; the old lines can be exactly identified, though each is accompanied by a new line. Hence the new map is something like what the old one would look if viewed through the medium of a doubly-refracting crystal, such as Iceland spar.

The discoveries of Schiaparelli had been made with the excellent 8-inch equatorial by Merz, in the possession of the Milan Observatory. But more powerful means were soon placed at his disposal, and in 1886, when Mars was again in opposition, he was able to examine the planet with an 18-inch telescope by the same maker and of the same excellent construction.

In the same season M. Perrotin, of the Nice Observatory, examined Mars with the 38-centimetre ($=7\frac{1}{8}$-in.) equatorial. After several attempts he succeeded in detecting the gemination of many of the mysterious lines, and his observations were checked over by M.M. Thollon, Gautier, and Trépied. Thus was obtained a full confirmation of the beautiful discoveries of Schiaparelli on the singular physical constitution of Mars.

(To be continued)

LUMINOUS OR SILVERY CLOUDS.

According to the opinion of Professor W. Kohlrausch, the luminous phenomena in the sky from November, 1883, to the summer of 1884, during which time splendidly illuminated clouds appeared with great frequency, were produced by volcanic eruptions, although it may also be assumed that the matter of these luminous clouds came from the regions of space. O. Jesse (*Meteorologische Zeitschrift*, v. p. 90) considers the former view the more probable; and, without professing to give a final decision on the whole question, he endeavours to explain the striking fact that between the first appearance of the intense purple light and the first occurrence of the luminous clouds an interval of eighteen months could elapse.

According to Jesse, the luminous clouds consist of a number of minute crystals formed from certain very light gases of unknown nature under the influence of the low temperature of the upper regions of the atmosphere.

As Verbeck assumes, the mass hurled up from Krakatoa, which, on May 20th, 1883, reached a height of more than six miles, attained on August 26th-27th an altitude of from ten to twelve miles, a calculation which agrees fairly with the results of O. Jesse, who determines the height of the luminous stratum of vapour at about eleven miles. Without question the matter ejected from the volcano consisted of solid particles of dust, and also of gases. The latter, with the exception of the condensed watery vapour, were diffused in the air. These gases, in consequence of their rapid ascent, were diffused not in the lower but in the upper regions of the air, and were then lost in space, if we admit that there is no hard and fast boundary between space and our atmosphere. Such a gas, whose point of condensation was not too low, might in consequence of this ascent arrive in regions of such a temperature that it would become liquified. By the rapid evaporation of the liquid thus formed we have a further reduction of temperature and a consequent formation of crystals. In the strata where this crystallisation takes place, the atmospheric air will be freed from the foreign gases, so that further quantities of the same may make their way upwards from the lower strata. It is plain that the gas in question may even be heavier than atmospheric air, but in consequence of the mutual interpenetration of gases it may still arrive at very great altitudes, though more time must elapse before the stage of crystallisation is reached.

After the congelation the crystals fall down into lower and consequently warmer regions of the air until again an evaporation and an ascent takes place. These circumstances may be sufficient to explain the extremely rapid changes of form of the luminous clouds.

More difficult is the explanation in what manner the scattered crystals arrange themselves in large masses so as to form a luminous cloud by the coalescence of minute corpuscles. Here then come into play processes similar to those, in consequence of which thinly-scattered particles of vapour are agglomerated to form sharply defined thunder-clouds. For the coalescence of the widely diffused crystals a considerable time must be required, and we may thus understand the long interval between the eruption of Krakatoa and the first appearance of the luminous clouds.

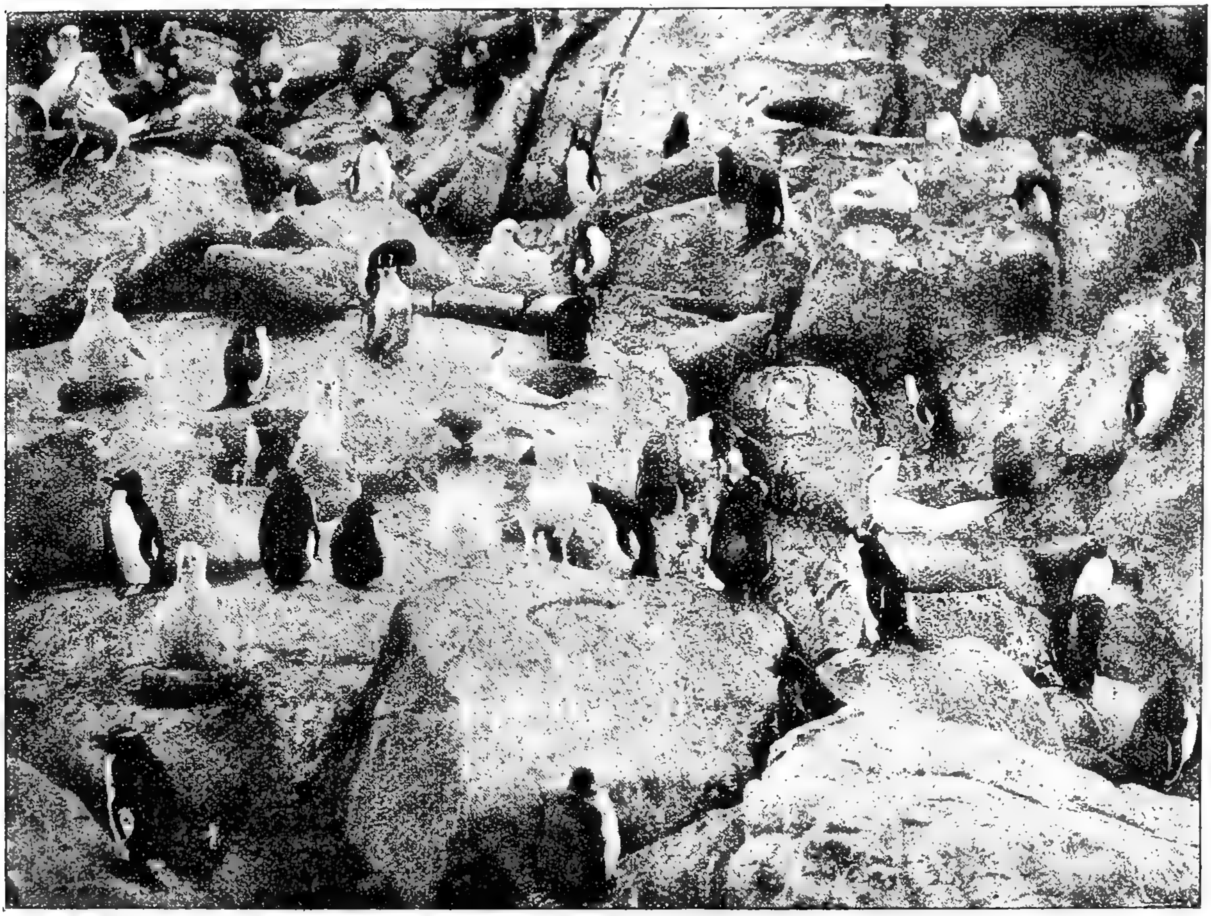
Jesse seeks to explain, further, the periodic appearance by the luminous clouds. Encke had formerly explained the prolonged revolution of the comet bearing his name by the supposition that space contains a resisting medium. William Siemens, in order to account for the constant renewal of solar energy, makes use of the hypothesis that the general space of our solar system is filled with gases which must be regarded as a continuation of the atmosphere of the sun and the planets. At the same time we may assume that the air of the interplanetary space lags behind the planets in their revolutions round the sun. Every planet will then experience a continual, but slow and partial, renewal of its atmosphere. In this manner the hemisphere which is turned towards the direction in which the earth is moving undergoes a constant afflux of matter from the regions of space, whilst from the opposite hemisphere there takes place a constant efflux. In the atmospheric strata, at from six to about sixty miles above the earth's surface, there may be a slight current in the direction opposite to her motion which carries along the minute solid particles suspended in the air. It would, therefore, be probable that the luminous clouds which since 1885 have been regularly seen in the months of June and July will be visible for half a year in the south temperate zone. It deserves notice that at the time of the Krakatoa eruption the north pole was turned towards the direction of motion of the earth, whence, in accordance with the above suppositions, the vapours of the eruption would extend more to the south than the north.

The above hypothesis does not explain the fact that since their first appearance the luminous clouds have considerably decreased. It is possible that the gas has entered into combinations which no longer admit of its ascent, or that the crystals formed in the upper regions of the air have been carried away by the above-mentioned current.

Natural History.

PENGUINS AND MOLLYHAWKS.

The penguins (*Aptenodytes*), a sub-family of the natatorial birds, represent in high southern latitudes the auks and divers of the north. Confined exclusively to cold regions, they abound in the Antarctic seas, and are so numerous that Dr. Bennett estimates the number of these birds on one island alone—Macquarrie's Island, in the South Pacific—to be at least from thirty to forty thousand. Sir James Clark Ross, in his "Voyage of Discovery in South and Antarctic Regions," mentions the immense numbers of penguins which surrounded him on all sides when he took possession, in the name of Her Majesty Queen Victoria, of the then newly discovered land Possession Island (now known as Victoria Land). He does not seem to have been greatly impressed by the appearance of the new annexation; the rocks were bare of vegetation, and there was nothing to be seen in any direction but penguin, penguin, *toujours* penguin. As these feathered inhabitants obviously objected to any sort of interference, manifesting their displeasure by vigorous pecks and blows, and as the odour from the guano, the accumulated deposit of many ages, was anything but agreeable, Sir James and his party were nothing loth to beat a hasty retreat from so inhospitable a shore. Mr. W. Dougall, of Invercargill, New Zealand, seems to have had a somewhat similar experience in his trip with Captain Fairchild in the *Stella* to the Auckland, Bounty, and Campbell Islands, in January of the present year. On every island they touched upon, penguins, mollyhawks, albatrosses, and ice-birds were in proud possession, and on the Bounty Islands, a compact group about 130 miles from the Antipodes Islands, consisting wholly of bare rocks absolutely destitute of vegetation and covered with guano, these birds, especially the two former, teemed in perfect myriads. Mr. Dougall succeeded in taking a series of photographs of these islands, although, owing to the slipperiness of the guano, he found it a matter of no slight difficulty both to get the camera safely to any point of vantage and to keep it steady when there. The fourteen islands which form the groups average about thirteen acres each in extent, and Mr. Dougall asserts that there must have been at least a dozen penguins on every square yard, while the water around was simply alive with them.



Penguins and Mollyhawks on the Bounty Islands.
(From an Instantaneous Photograph taken by Mr. W. Dougall, of Invercargill, N.Z.)

On the shores of South Patagonia these birds abound in such numbers that 300 have been taken within an hour, while in an islet in the Straits of Magellan Captain Drake's crew once killed more than

3,000 in one day, a statement which, in spite of its magnitude, may yet be accepted with a fair amount of credulity, since these navigators were probably the first human beings to set foot on the island, and the birds had been free from molestation for unknown generations.

The penguin rarely quits the vicinity of land, never appearing at great distances out to sea, and are in the habit of forming perfect little colonies in their island homes.

During the Transit of Venus Expedition to Kerguelen Island the Rev. A. E. Eaton, naturalist to the expedition, found that some of the penguin colonies only contained about twelve nests, while others had from 70 to 150, and some of the officers visited a very populous "penguinery," which contained about 2,000.

These large communities were approached from the sea by well-worn paths, almost like sheep-tracks. Dr. Bennett has a theory that the sitting hens, young birds, moulting birds, and clean birds all form distinct classes of the community, and that the line of demarcation between the several classes is strictly defined, no clean bird, for example, being allowed to assort with a moulting bird. The nests are of simple construction, generally a mere hole scraped in the ground, lined with a few dried leaf-stalks and seed-stems of the *Pringlea*. The female seldom lays more than one egg, greyish white in colour, and this egg she never leaves for many moments until it is hatched. She holds it close to her thighs, and if approached during incubation she briskly, if inelegantly, waddles off, carrying her egg with her. During this time the male bird goes to sea for food for the female, who soon grows fat, but as soon as the young bird is hatched both parents go to sea in search of food, and the young bird grows fat in proportion as the old ones get thin. Captain Fitzroy declares that the old birds, when they arrive with the food supplies, solemnly get on a little eminence and make a great noise, between quacking and braying, as if haranguing the penguinery, only interrupting the thread of their discourse to allow the young ones to take their food. Although at first the penguins seemed to have had not the slightest fear of man, they are apparently beginning to associate his appearance with discomfort, if not with death, and the male birds now sometimes take to flight. The females only run a very little distance, often turning round to see how matters are proceeding, and generally returning at once to the nest. The young apparently do not object to strangers, and prefer remaining in the nest, submitting with perfect willingness to be stroked by the intruder, however much the anxious mother may peck at his legs and otherwise betray her disapproval of his presence. A little later in life the youngsters when returning to the nest at night will sometimes linger behind, but are sharply rebuked by the community for such irregular proclivities, all the penguins safely at home giving the truant latecomers severe digs and pecks as they pass them on their homeward way. Mr. Eaton states that the penguins, or "Johnnies," as the whalers call them, are very regular in their habits, repairing every afternoon, when their fishing operations are over, to the shore, where they land in small parties at their accustomed places, and rest quietly on the beach with their heads sunk between their shoulders and their bills up in the air, much after the fashion of very young thrushes. They will commence the ascent to their homes with great energy, but soon begin to slacken their pace, and when once thoroughly tired out no amount of persuasion, even if administered with suasive force by the toe of a boot, will induce a penguin to continue his journey until he chooses. If knocked right over, the "Johnnie" will only pick himself up to peck at the offending boot; and if further measures be resorted to, he simply turns tail, and betakes himself headlong to the sea. A penguin's gait is not as dignified as its erect appearance might lead one to suppose. Its legs are very far back, and its feet broad, almost like the sole of a quadruped's foot, so it stands extremely well, but at each step its body turns from side to side, its feet almost crossing each other, with a decidedly inelegant effect. Its little wings, utterly ineffectual though they be for flight, are not only very powerful swimming agencies, but act as very efficient fore-feet in an emergency on land, and if greatly alarmed a penguin makes off, literally on all fours, with such speed that a careless observer might easily mistake the bird for a low-bodied quadruped. In colouring the penguin is almost a harmony in black and white. The upper part of the head and throat is black; the back dark bluish grey, so dark as to be almost black; the under surface pure silvery white; the bill black; legs and feet black. The one touch of colour is supplied by the broad band of light yellow which runs down the side of the head, narrows towards the middle of the throat, and then merges on either side into the dazzling white of the bird's breast. Its feathers are all set in the peculiar fashion common to the natatores, or swimming birds, and together with the thick under-coating of down, render it impervious to cold and wet. The penguin invariably sits erect in its roosting-place, and unless agitated or hurried, walks upright to the sea, where it throws itself on its breast to encounter the rough seas that break over those shores. The cry of the penguin somewhat resembles the bark of a fox, and the combined noise from an army of penguins is something considerable; indeed, their nocturnal cries have sometimes served as timely warnings to navigators steering in the wrong track. The total length of a penguin averages about three feet, its tail being so rudimentary that it counts but little in the measurement, and the weight averages from thirty to forty pounds. There are several species of penguins, the handsomest being probably the Crested Penguin (*Eudypes chrysocoma*) of Patagonia, a bird with a fine crest of yellow feathers, which it can erect or depress at will, and with a strange habit of throwing its head backwards when on land, and making an extraordinary loud noise, not unlike the braying of an ass, which has gained for it the name of "Jackass Penguin" among sailors.

The Mollyhawk in our illustration is the Antarctic skua (*Stercorarius antarcticus*), a strong, rapacious brown bird, of the family *Laridæ* (gulls), closely akin to the common skua (*S. catarrhactes*) of the Shetland Islands. The Rev. A. E. Eaton states that during the above-mentioned expedition the skuas were at first very plentiful on Kerguelen Island, but were destroyed in great numbers by the sailors, not in mere wantonness, but in self-defence, for the bird had a menacing habit of "swooping with fierce impetuosity directly towards the face of any one approaching their domain, rising only just in time to clear his head, and uttering sharp, despairing cries." As the sailors learnt their method of attack, they simply held a knife, point upwards, above their heads when searching for eggs, and on this knife the skuas would often transfix themselves in their fierce downward swoop. They never, like the skuas in Spitzbergen, feigned to be helpless and crippled to avert danger from their nest, but preferred, at all costs, their intimidation tactics. If they thought they had succeeded in driving away the enemy, they would stand face to face upon the rock, flapping their wings and uttering loud croaks, as if in triumph over their victory. They sometimes croak during flight, their notes much resembling those of the raven or crow; and as their flight also bears some slight resemblance to that of crows, they are sometimes known among sailors as "black crows" and "sea crows." Their more general *sobriquet*, however, is that of "Mollyhawk," from their hawk-like persecution of the petrels, or "Mollies," their staple article of food, though they devour indiscriminately fish, mollusks, birds, or small animals. They chase the petrel by day at sea, killing it while on the wing, and in the evening hunt for them along the shore, flying low and rapidly, ready to pounce like hawks upon any unfortunate petrel emerging from its burrows. This course of conduct they pursue early in the morning as well, and as they are skilful in robbing the petrel's eggs, besides killing the bird itself, it may well be imagined that the skua is an object of great dread to the petrel. Mr. Eaton is of opinion that the skuas are rather perplexed when rabbits occasionally emerge from the burrows instead of the expected petrels, but thinks that even this unusual food would not come amiss to the rapacious robbers, since tame skuas have been known to devour young rabbits. The skua only visits the shore for breeding or pillaging purposes, preferring at other times the open ocean. Its nest is roughly constructed of dried grass, or sometimes, in default of other material, of hard-dried guano; and the two eggs are dark olive-green, blotched with brown. It is most courageous in defence of its young; it allows no other birds anywhere near its nest, and does not hesitate to attack even man if danger threatens the nest. Sailors find the eggs of both penguins and skuas fairly good, but the flesh of both birds is extremely unpalatable, although it is sometimes the only resource for ships' crews in the way of "fresh meat." In order to render it fit for eating at all, the sailors skin the birds and hang them up for some days, leaving them exposed to the evening dew for two or three nights, a process by which some of the disagreeable odour and flavour are said to be removed.

Our illustration is taken from one of Mr. Dougall's photographs of the Bounty Islands, kindly supplied to us by Mr. Joplin, of Stamford, who has a large selection for sale.

Race between Carrier Pigeons and Bees.—A singular wager (*Cosmos*) has been won by a farmer, who is at the same time a pigeon fancier, at Hamme, in Westphalia, against some inhabitants of the town. The bet was that bees, conveyed in fine weather to a distance of a league from Hamme, and let loose at the same time as certain carrier pigeons deposited at the same place, should reach their hive sooner than the pigeons should arrive at their house. On July 25th, at 4 p.m., twelve pigeons and twelve bees belonging to Mr. R. were let loose at Rhysern, a place distant a good league from Hamme. In order to recognise the bees they had been dusted with flour. All the parties stood near the hives of Mr. R., where they could at the same time watch the dove-cot. The first bee, covered with flour, arrived a quarter of a minute before the first pigeon, and the rest of the two troops of aerial travellers arrived at the same second a few instants later.

Evolution in the Song of Birds.—Mr. E. P. Powell, of Clinton, communicating to *Science*, gives some interesting cases of an evolution in the song of the (American) robin, a member of the thrush family. He considers that "with birds evolution must move, as it has moved, in the line of music, plumage, flight, and nest-building." Let us hope that it will not be brought to an untimely end by the extirpation of the little songsters.

Dipterous Larvæ Parasitic in Man.—Portchinski (*Humboldt*) shows that the majority of the cases of disease in human subjects, occasioned by the maggots of flies, are due to *Sarcophagi Wohlfahrti*. He gives this name to the insect in honour of Dr. Wohlfahrt, of Halle, who first described the fly, and proved its parasitic character by rearing it from larvæ *sneezed out* by a man who had been driven almost frantic by headache. *S. Wohlfahrti* seems accordingly to be the European representative of the American fly, *Lucilia hominivora*. According to Meinert, a species of *Lucilia* is parasitic on man also in Europe.

The Heat-Centres in Man.—At the recent meeting of the American Neurological Society, Dr. Ott, of Easton, showed that in the brain of man there are points which preside over the temperature of the body and keep its heat constant. These centres are partly upon the surface and partly at the base of the brain.

Poison Apparatus of the Mosquito.—Mr. G. Macloskie (*Science*) has described and figured the poison apparatus of the mosquito.

Twin Fruits.—Mr. John J. Janney (*Science*) writes that in the year 1851 his garden produced abundant specimens of twin fruits, peaches and plums of various sorts, cherries, apples, and cucumbers. Some of these were but slightly attached together at the foot stalk, whilst others coalesced for their whole length. As similar fruits were common in the markets at the same time, the cause must probably have been seasonal.

Besieged by Bears.—The official journal of the Government of Olonetz reports that the district of Welikogub is regularly blockaded by bears. In five villages the inhabitants do not dare to venture beyond the boundaries. Although not more than 100 miles from St. Petersburg, the district is encompassed by primæval forests, stretching hundreds of versts in every direction. Here bears seemed to have formed a regular settlement. They form groups of seven or eight, and, descending into the cultivated patches, attack the horses and horned cattle, reducing the peasants to despair, making them afraid to till their fields. Their terror is so great that none of them will any longer venture into the forest. The aid of the local authorities has been frequently invoked, in vain; and the peasants were looking forward, as a last hope, to the autumn *battues* of the soldiers of the district, who will, according to usage, organise regular bear-hunts.

THE SENSES OF INSECTS.

II.—Sight.

Although the question would at first seem almost superfluous, it is somewhat difficult to determine whether or not Sight is the most important of the senses which insects possess. On the one hand it is argued, and with great show of reason, that the eyes are generally very numerous, that they command a wide field of view, and that they are mostly present in two, or even in three different forms—strong evidence, one would think, in favour of an affirmative reply to our query. But it is contended, on the other hand, that there are many insects—notably several of the myrmecophilous beetles—which have no eyes at all, while it has also been asserted that, owing to the convexity of the facets which make up the compound eyes, vision, even when present, can only be found of service at close quarters; in other words, that insects are short-sighted.

On this point, therefore, evidence is somewhat conflicting, and it is not very easy to arrive at any definite conclusion. But it is, at all events, well to point out that the arguments of those who deny the importance of the eyes are open to considerable objection. For, in the first place, those insects which are blind are almost invariably dwellers underground, where eyes can be of no possible service. And it would be as reasonable to argue, because they lack those organs, that therefore eyes are not of the highest importance to insects in general, as it would be to urge the eyeless condition of certain cave-dwelling fish as the base for a similar contention with regard to the piscine race.

And with respect to the second assertion, viz., that insects are short-sighted, little or no proof has been brought forward in its support. And we know, without a doubt, that many insects can see for considerable distances. Moths, for instance, are attracted to a gas-lamp hundreds of yards away; and though it may be urged that they receive but a blurred and ill-defined impression of the flame until they approach it closely, the fact remains that their vision is at least in some degree serviceable in perceiving distant objects. And he would be a bold man who should lay down the limit at which that vision ceases to be accurate.

On the other hand, it is impossible to over-estimate the importance of the fact that the facets of the eye-masses are exceedingly numerous, more especially since they are so set as to command a view in almost every direction without any necessity for turning the head. And the number of these facets is at least in some degree proportionate to the speed and activity of the individual species; for the more agile insects would, of course, require the more perfect sight. Thus in the ant, which is comparatively slow in its movements, and in which flight is restricted to the single ascent made by the males and females before pairing, there are no more than fifty distinct facets in the eye. In *Blaps mucronata*, which is one of the most sluggish of our British beetles, there are perhaps two hundred and fifty. In *Meloë*, which, although slow of foot, occasionally exhibits some approach to activity, there are about twice as many. But in certain dragon-flies, which are the analogues among insects of the hawks among birds, there are twelve thousand or more; in some swift-winged butterflies there are seventeen thousand; and in a certain active beetle (*Mordella*) there are more than twenty-five thousand. There are exceptions to the rule, no doubt, but it seems a fairly regular one upon the whole; and its bearing upon the importance of the visual organs cannot be overlooked.

Besides these compound eyes, there are in most insects, though not in all, a very limited number of simple eyes, or *ocelli*, which are generally situated upon the upper part of the head; and these bear a distinct resemblance, as far as the general character of their structure is concerned, to the eyes of the higher animals. In the words of Mr. Rymer Jones, each of these eyes "consists of a minute smooth, convex, transparent cornea, in close contact with which is a small globular lens; behind this lens is placed the representative of the vitreous humour, upon which a nervous filament spreads out, so as to form a retina. The whole is enclosed in a layer of brown, red, or black pigment, which, bending round the anterior surface of the eye, forms a distinct coloured iris and pupillary aperture."

These simple eyes are sometimes present alone, as in the *Thysanura*. Sometimes they are wanting, as in the great majority of the *Coleoptera*. But usually they are present in addition to the compound eyes, and, being directed towards the zenith, command just that quarter which is beyond the ken even of the higher facets of the compound eyes.

These facets, whatever their number, are always hexagonal, and are agglomerated into two great masses, one of which is situated upon either side of the head. In the Whirligig Beetles (*Gyrini*), which skim about on the surface of ponds, etc., each of these eye-masses is divided in two by a corneous ridge, so that, practically speaking, the compound eyes are four in number, the upper pair being available for use in the air, while the lower pair, which alone are immersed, are equally available for use in the water. In almost all cases they project well beyond the level of the cheeks and temples, as perhaps for the sake of analogy we may be permitted to term them, so that the field of view which they command is remarkably extensive, and scarcely any point of the compass is altogether out of sight.

Each of these numerous facets is provided with its own optic nerve; and these nerves, radiating, as it were, from a common centre, transmit the impressions which they receive to a common retina. Behind this is a mass of nervous matter, which leads direct to the brain, or rather to the cephalic ganglion which represents that organ; and this mass communicates with the general retina by what are known as "secondary" nerves, and which are very short and delicate.

Passing to the eyes themselves, each facet is furnished with, or itself consists of, a double convex lens, so formed as to bring to a focus the rays passing through it. Behind every such lens is a six-sided transparent prism, analogous to the vitreous humour in the eyes of higher animals; and to the bases of these prisms are attached the optic nerves.

It has long been a question with anatomists whether insects do, or do not, see with more facets than one at once. That all should be simultaneously employed, or should carry independent impressions to the brain, is manifestly impossible; and two theories have been put forward with the view of clearing up the difficulty. One of these is to the effect that, although all the facets simultaneously see, they convey but one common impression, just as one impression only is borne to the brain by our own two eyes. But as the facets are set in different directions, this explanation is clearly inadmissible. The second theory suggests that one facet

—or at least one small group of facets conveying a common impression—is employed at any given moment, and that the remainder see only in a blurred and confused manner, just as we ourselves dimly see neighbouring objects when gazing into the far distance. This is more probable; but in the present incomplete condition of our knowledge it is quite impossible to pronounce upon the point with any degree of certainty.

Eyes of a third description we find in certain aphides, in the form of supplementary "eye-tubercles," two in number, one of which is situated at the corner of each of the compound eyes. These eye-tubercles are furnished with from five to ten facets apiece, differing little, structurally speaking, from those of the compound eyes, but hemispherical instead of hexagonal. Their particular function is altogether unknown, as is also the reason why aphides, which are for the most part very sluggish creatures, should possess numerous and well-developed eyes, and in three forms instead of in two. But then aphides are in many ways most exceptional beings.

Seeing, then, the highly-developed character of the eyes of insects, their invariable presence in those species to which they could by any possibility be of service, and the utter absence of proof to the effect that their range of vision is so limited as has sometimes been contended, we may surely concede that sight *is* the most important of an insect's senses, and that it is generally present in a very remarkable degree.

Reviews.

On the Distribution of Rain over the British Isles during the Year 1887, *as observed at more than* 2,500 *Stations in Great Britain and Ireland, with Articles upon various Branches of Rainfall Work.* Compiled by G. J. Symons, F.R.S. London: Edward Stanford.

The author remarks in his preface that the year 1887 seems to have had no equal for wide-spread deficiency of rainfall since 1788! He further expresses the opinion that "if the drought from 1738 to 1762, indicated by the observations already collected, is real and recurs, not only will every town in England which receives its water supply from a gathering-ground be put on short supply, but the canals will have to be closed and agricultural operations will have to be modified."

This passage was, of course, written before the present season declared its character. There is now little fear of a short water supply or of the closing of canals, and as to agricultural operations they seem in danger of being suspended altogether. In his first chapter the author endeavours to give a fixed meaning to the terms "absolute droughts" and "partial droughts." By the former he proposes to understand times of more than fourteen days absolutely without rain. The partial drought is to signify times of more than twenty-eight consecutive days, the aggregate rainfall of which does not exceed 0·01 in. daily. A further form of drought receives the rather curious name of "engineers' drought," that is, a drought which an hydraulic engineer must provide against in drawing up a scheme for a water supply, and such drought he defines as a time of "three or more consecutive months, the aggregate rainfall of which does not exceed half the average."

The account of "historic droughts" in the British Islands, from the third century downwards, is especially, in its earlier parts, open to doubt. In our days "burning summers," "scorching heat," etc., are exceedingly rare phenomena.

The observations made last year show a striking deficiency of rainfall, the aggregates ranging up to 17 in. below the averages of former periods. The heaviest fall recorded in any twenty-four hours is that at Queen's College, Galway, on September 1st, amounting to 4·93 in. The accounts of the water famine prevailing during September in various parts, both of England and Ireland, are very striking. In most parts of the British Isles, however, the dry weather was not accompanied by any unusual heat. Chilly polar winds counteracted the effects of bright sunshine by day, and, as we learn from other sources, the temperature, save perhaps in July, was from 2° to 3° Fahr. below the average.

The Scientific Proceedings of the Royal Dublin Society. Vol. V. (N.S.), Parts 7 and 8. July and November, 1887. Vol. VI. (N.S.), Parts 1 and 2. February and May, 1888.

The subjects considered in the parts before us are chiefly either of a geological or a physical character. Mr. A. B. Wynne treats of submerged peat-mosses and trees in certain lakes of Connaught. The author, to account for tree-stumps standing erect under water as if they had grown there, suggests that the stools of the trees in the bogs with horizontal roots retained their position until the boggy ground they grew in had been almost entirely removed. In case of an unusual storm the remaining roots snapped or drew, and each water-logged mass subsided to the bottom, settling upon its broadest surface still in its natural position of growth.

Mr. G. H. Kinahan, M.R.I.A., discusses the deal timber in the lake basins and peat-bogs of north-east Donegal, with especial reference to the fact that the stumps, locally called "corkers," are found *in situ* below the present level of natural drainage. He formerly thought that the flooding of the hollows might be due to beavers. He notes, however, that in Irish, unlike Welsh or Gaelic, there is no name for a beaver, and he has not been able, in Donegal, to recognise any beaver workings, with the features of which he has become acquainted in Canada. He now, with Mr. Plunkett, holds that the trees grew in flats and hollows without drainage outlets in periods when the climate was hotter and drier than at present. When a wetter and colder epoch succeeded the flats and hollows became submerged.

Professor Hall, F.R.S., communicates an important paper on the "Effect of Continental Land in Altering the Level of the Ocean." The author quotes the opinion of Professor Ed. Suess, expressed in "Das Antlitz der Erde," that the surface of the ocean along the margin of a continent may be as much as 3,300 feet higher than the surface along the shores of a mid-oceanic island. The difference of level along the coast of Mexico and at the Sandwich Islands is said to be no less than 4,520 feet.

Professor W. J. Sollas, in a contribution to the "History of Flints," concludes that a bed of average-sized flints may be formed in about fifty years, more or less—a much shorter time than would have been expected.

R. F. Scharff, Curator of the Natural History Department in the Dublin Museum, reviews Dohrn's theories on the origin of the vertebrates. Dohrn draws attention to the fact that his views differ from the current ideas in three main points: the derivation of the vertebrates from worm-like ancestors; that the principle of change of function was the best guide in tracing morphological histories; and that degeneration might proceed to an unlimited extent. In his first paper he holds that the mouth of living vertebrates has originated from a union of two gill-clefts. He regards the hypophysis in Teleosteans as a pair of præoral gill-clefts arrested in their development in such a manner as not to reach the surface of the skin. In Petromyzon he considers that the so-called nasal organ probably still retains to some extent the function of a gill. All previous observers, including Balfour and Gegenbaur, had regarded the visceral arches of the Elasmobranchs as equivalent to the arches in Petromyzon. Dohrn, however, proves that the external cartilages have nothing to do with the arches of Petromyzon. The tunicate eye is regarded by Dohrn as having degenerated from the vertebrate eye to its present condition.

Research. A Monthly Illustrated Journal of Science. Vol. I. No. 4. October 1st, 1888.

The first article in the issue before us, "On Science Teaching in Schools and Colleges," appeals strongly to our sympathies. We most cordially endorse the remark that:—"The examination system of this country requires a most thorough overhauling and remodelling, and in no subjects more so than in science. At present it is to a great extent a curse and hindrance to true scientific progress."

But we feel inclined to go a little further than our contemporary, and to ask if the exceptional stress laid upon examinations in this country is not a main cause of our unsatisfactory position in science?

In the notice of the recent meeting of the British Association, it is very appropriately said that in the address to Section F. the line between science and politics was overstepped more than once.

Mr. T. Mellard Reade, in a paper on "Mountain Formation," seems to accept the theory of Sir W. Thomson, that the earth from the centre to the circumference is "as solid as steel."

There is a bright little article on "Llandudno and its Flora," which will doubtless prove a boon to phytologists visiting that popular watering-place.

The Sixty-fifth Report of the Sheffield Literary and Philosophical Society, for the Year Ending December 1887. Delivered at the Annual Meeting, January 3rd, 1888. Sheffield: Leader and Sons.

The Sheffield Literary and Philosophical Society is a favourable specimen of a number of societies instituted in the first quarter of the present century, for the joint cultivation of literature and science. Exception may, perhaps, be taken alike to the name and to the scope of these bodies. The term "philosophical," save in the phrase "philosophical instruments," is no longer used as a synonym for "scientific." As to the scope of the Society, we often find that literature serves for a disguise under which almost anything may be introduced. As, further, the relations between science and literature are, to say the least, somewhat strained, such bodies would probably be the gainers in efficiency by submitting themselves to a process of dissociation.

Among the papers, etc., printed in this report, literature seems to predominate, if we may judge from the space allotted to "Samuel Bailey, the Bentham of Hallamshire," to "Half-hours with Charles Dickens," and to the "History of a Fascination."

In the first of these memoirs politics crop up to an extent very undesirable.

Of the scientific papers the most important are "The Discovery of the Planet Neptune," by Mr. B. D. Wrangham; "The Principal British Poisonous Plants, and How to Distinguish Them," by the President, Mr. E. Birks; "The Perception of Odours, and the Mistakes of the Colour Blind," by Mr. Simeon Snell; and "Studies in the Border Land of Geology and History," by Dr. H. C. Sorby, F.R.S. We doubt, however, if any of these papers, save the last, makes additions to our former knowledge. In other words, the Society is not engaged to any appreciable extent in the work of original observation and research. May we not here hope for a reform?

Third Annual Report of the City of London College Science Society, 1887-8. London: Howes.

This report shows a very satisfactory activity.

We notice, firstly, a very able paper by Professor G. S. Boulger, F.L.S., on the "Use of Experiment in Biology." We are disposed to agree with him in rejecting as vicious the commonly made distinction between the experimental and the observational sciences, and in regarding experiment as absolutely essential to the advancement of biology.

Mr. G. E. Mainland gave a paper on "Spiders," contrasting the classes *Arachnida* and *Insecta*.

"The New Darwinism; or, the Segregation of the Fit," was discussed by Mr. J. W. Gregory, who curiously still admits the doctrine of the sterility of hybrids. He grants the existence of a fertile hybrid between the hare and the rabbit; he will not be able to deny the similar case of the American bison and the domestic cow, or of the carrion crow and the hoodie, not to speak of the multitudes of fertile hybrids in the vegetable kingdom. Therefore, as a law of nature can admit of no exceptions, the dogma of the infertility of hybrids falls to the ground, and to admit it is to give to the Old School an advantage to which they are not entitled.

THE FOUNDATION-STONES OF THE EARTH'S CRUST.

An Evening Discourse delivered by T. G. Bonney, D.Sc., LL.D., F.R.S., F.G.S., etc., before the British Association, on September 10th, 1888.

Do we know anything about the earth in the beginning of its history—anything of those rock masses on which, as on foundation-stones, the great superstructure of the fossiliferous strata must rest? Palæontologists, by their patient industry, have deciphered many of the inscriptions, blurred and battered though they be, in which the story of life is engraved on the great stone book of Nature. Of its beginnings, indeed, we cannot yet speak. The first lines of the record are at present wanting—perhaps never will be recovered. But apart from this: before the grass and herb and tree, before the "moving creature in the water," before the "beast of the earth after his kind," there was a land and there was a sea. Do we know anything of that globe, as yet void of life? Will the rocks themselves give us any aid in interpreting the cryptogram which shrouds its history, or must we reply that there is neither voice nor language, and thus accept with blind submission, or spurn with no less blind incredulity, the conclusions of the physicist and the chemist?

The secret of the earth's hot youth has doubtless been well kept. So well that we have often been tempted to guess idly rather to labour patiently. Nevertheless we are beginning, as I believe, to feel firm ground after long walking through a region of quicksands; we are laying hold of principles of interpretation, the relative value of which we cannot in all cases as yet fully apprehend—principles which occasionally even appear to be in conflict, but which will some day lead us to the truth.

I shall not attempt to give you an historical summary, but only to lay before you certain facts for which I can answer, and to indicate the inductions which these, as it seems to me, warrant. If I say little of the work of others, it is not from a desire of taking credit to myself, but because it is immaterial for my present purpose, who first made a particular observation and how far his inductions therefrom were correct. The acknowledgment of good work would involve repudiation of bad, and for that, so far as persons are concerned, it seems hardly fair to use the present occasion. So, in the outset of this lecture, I will once for all make a statement which I have sometimes thought of invariably using, like a prefatory invocation, "You are free to suppose that everything herein has been said by somebody, somewhere," but I will add that, as far as possible, every assertion has been personally verified.

The name Cambrian has been given to the oldest in which fossils have been found. This group forms the first chapter in the first volume, called Palæozoic, of the history of living creatures. Any older rocks are provisionally termed Archæan. These—I speak at present of those indubitably underlying the Cambrian—exhibit marked differences one from another. Some are certainly the detritus of other, and often of older, materials—slates and grits, volcanic dust and ashes, even lava-flows. Such rocks differ but little from the basement beds of the Cambrian; probably they are not much older, comparatively speaking. But in some places we find, in a like position, rocks, as to the origin of which it is more difficult to decide. Often in their general aspect they resemble sedimentary deposits, but they seldom retain any distinct indications of their original fragmental constituents. They have been metamorphosed, the old structures have been obliterated, new minerals have been developed, and these exhibit that peculiar orientation, that rudely parallel arrangement, which is called foliation. Except for this some masses are fairly homogeneous, while some exhibit a distinct mineral banding which is usually parallel with the other structure. These rocks are the gneisses and schists—the latter term, often vaguely used, I always restrict to rocks which exhibit a true foliation. In some schists the mineral constituents are comparatively minute, in others they are of considerable size. In the former case we may often venture to affirm that the rock is a metamorphosed sediment; in the latter its original condition is a matter of conjecture. Rocks of the former class often appear, to use no stronger word, to lie above, and so to be less ancient than those of the latter, and beneath that comes a coarser and more massive series, in which granitoid rocks are common. In these last foliation is often inconspicuous, and the rocks in consequence are not markedly fissile.

That these rocks are older than the Cambrian can often be demonstrated. Sometimes it can even be proved that their present distinctive character had been assumed before the overlying Cambrian rocks were deposited. Such rocks, then, we may confidently bring forward as types of the earth's foundation-stones. As the inscriptions buried in the Euphrates valley tell us, the tongue of Accad in the days prior to the coming of the Semite, so these declare what then constituted the earth's crust. If in such rocks we find any peculiarities of mineral composition or structure, these may legitimately be regarded as distinctive. We have only to beware of mistaking for original those which are secondary and subsequently impressed.

In other parts of the world we find rocks of like characters with those above named, the age of which cannot be so precisely fixed, though we can prove them to be totally disconnected from and much older than the earliest overlying stratum. To assert that these rocks are contemporary with the others is obviously an hypothesis which rests on the assumption that community of structure has some relation to similarity of origin. I am well aware that attempts have been made to discredit this. But if we eliminate difficulties which are merely sophistical—those, I mean, created by the use of ambiguous or misleading terms—if we acknowledge those due to our limited means of investigation, such as that of distinguishing a rock crushed *in situ* from one composed of transported fragments—in other words, of separating in every case a superinduced from a primary structure—and if we allow for others due to the limitation of our instrumental and visual powers, I do not hesitate, as the result of long and, I hope, careful work, to assert that certain structures are very closely related to the past history of a rock, and that in very many instances our diagnosis of the cause from its effect is not less worthy of confidence than that of an expert in pathology or physiology. Resemblances of structures, different in origin, do, no doubt, sometimes occur—resemblances not seldom due to partial correspondence in the environments; but in regard to these it is our duty to labour patiently till we succeed in distinguishing them. The difficulty of the task does not justify us, either in abandoning it in despair, or in sitting down, after a few hasty observations, to fashion hypotheses which have no better foundation than our own incompetence or idleness.

As it is impossible in the time at my disposal to demonstrate the proposition, I must assume what I believe few, if any, competent workers will deny, that certain structures are distinctive of rocks which have solidified from a state of fusion under this or that environment; others are distinctive of sedimentary rocks; others again, whatever may be their significance, belong to rocks of the so-called metamorphic group. I shall restrict myself to indicating, by comparison with rock structures of which the history is known, what inferences may be drawn as to the history of the last-named rocks, which, as I have already stated, are in some cases examples of the earth's foundation-stones, while in others, if they are not these, they are at any rate excellent imitations.

Let us proceed tentatively. I will put the problem before you, and we will try to feel our way towards a solution. Our initial difficulty is to find examples of the oldest rocks in which the original structures are still unmodified. Commonly they are like palimpsests, where the primitive character can only be discerned, at best faintly, under the more recent inscription. Here, then, is one of the best which I possess—a Laurentian gneiss from Canada. Its structure is characteristic of the whole group; the crystals of mica or hornblende are well defined, and commonly have a more or less parallel arrangement; here and there are bands in which these minerals are more abundant than elsewhere. The quartz and the felspar are granular in form; the boundaries of these minerals are not rectilinear, but curved, wavy, or lobate; small grains of the one sometimes appear to be enclosed in larger grains of the other. Though the structure of this rock has a superficial resemblance to that of a granite of similar coarseness, it differs from it in this respect, as we can see from the next instance, a true granite, where the rectilinear outline of the felspar is conspicuous. Here, then, is one of our problems. This difference of structure is too general to be without significance. What does it mean?

It is more difficult to obtain examples of schist of like geological age, wholly free from subsequent modification. Apparently the structure and the composition of the rock have rendered it more liable to disturbance. But those exhibited, though by no means perfect examples, may serve to indicate the structure of an Archæan schist, consisting mainly of quartz and mica. We may take them as representative of a considerable series of rocks, which are often associated in such a manner as to suggest that, notwithstanding their present crystalline condition, they had a sedimentary origin. Can this inference be justified?

How shall we attack this problem? Clearly, the most hopeful way is by proceeding from the known to the unknown. Now, among the agents of change familiar to geologists, three are admittedly of great importance; these are water, heat, and pressure. As probably almost all changes in nature, with which we have to deal, have occurred in the presence of water, but those due to it alone are generally superficial, I shall assume its presence, and not attempt to isolate its effects. But we must endeavour to ascertain the results of pressure and heat, when acting singly and in combination, in modifying rocks of a known character; admitting, however, that probably while the one agent has been dominant, the other has not been wholly inoperative.*

The first effect of pressure due to great earth-movements is to flatten somewhat the larger fragments in rocks, and to produce in those of finer grain the structure called cleavage. This, however, is a modification mainly mechanical. It consists in a re-arrangement of the constituent particles, mineral changes, so far as they occur, being quite subordinate. But in certain extreme instances the latter are also conspicuous. From the fine mud, generally the result of the disintegration of felspar, a mica, usually colourless, has been produced, which occurs in tiny flakes, often less than one-hundredth of an inch long. In this process, a certain amount of silica has been liberated, which sometimes augments pre-existing granules of quartz, sometimes consolidates independently as microcrystalline quartz. Carbonaceous and ferruginous constituents are respectively converted into particles of graphite and of iron oxide. Here is an example of a Palæozoic rock, thus modified. It originally consisted of layers of black mud and grey silt. In the former, this filmy mica has been abundantly developed; it is present also, as we might expect, to some extent in the latter. Observe that the original banded structure, notwithstanding the pressure, has not been obliterated. Another point also demands notice. The black lines in the section indicate the direction of the cleavage of the rock, which is, roughly speaking, at right angles to the pressure which has most conspicuously affected the district, while the microfoliation, as we may call it, appears to be parallel to the original bedding, and is thus anterior to the dominant cleavage. The two may form parts of a connected series of movements, but, at any rate, they are so far separated that the pressure which produced the one, acted, roughly speaking, at right angles to that which gave rise to the other, and the folia were developed before they were bent and torn.

Let us now pass on to examine the effects of pressure when it acts upon a rock already crystalline. Here, obviously it is comparatively unimportant whether the original rock was a true granite or a granitoid gneiss; for at present we are only concerned with the effect of pressure on a fairly granular crystalline rock. But in the resultant structures there are, as it seems to me, differences which are dependent upon the mode in which pressure has acted. They are divisible into two groups: one indicating the result of simple direct crushing, the other of crushing accompanied by shearing. In the former case, the rock mass has been so situated that any appreciable lateral movement has been impossible; it has yielded like a block in a crushing-machine. In the latter a differential lateral movement of the particles has been possible, and it has prevailed when (as in the case of an overthrust fault) the whole mass has not only suffered compression, but also has travelled slowly forward. Obviously, the two cases cannot be sharply divided, for the crushing up of a non-homogeneous rock may render some local shearing possible. Still it is important to separate them in our minds, and we shall find that in many cases the structure, as a whole, like the cleavage of a slate, results from a direct crush; while in others the effects of shearing predominate. The latter accordingly exhibit phenomena resembling the effects of a tensile stress. Materials of a like character assume a more or less linear arrangement, the rock becomes slightly banded, and exhibits, as has been said, a kind of fluxion structure. This phrase, if we are careful to guide ourselves against misconception, is far from inappropriate. The mass gradually assumes a fragmental condition under the pressure, and its particles as they shear and slide under the effects of thrust behave to some extent like those of a non-uniform mass of rock in a plastic condition, as, for example, a slaggy glass. But we must be on our guard, lest we press the analogy too far. The interesting experiments which have been made on the flow of solids, and on rolled-out plastic substances, while valuable as illustrations, represent, as it seems to me, a condition of things which must be of rare occurrence in a rock mass, pulverised by mechanical forces only. If I am to reason from them, I must regard the rock not as a fragmental solid—if the phrase be permissible—but as an imperfect fluid; that is to say, I must consider them as illustrative of structures in rocks which have yet to assume—not have already assumed—a crystalline condition.

(To be continued.)

* Heat will, of course, result from the crushing of rock. This some consider an important factor in metamorphism, but I have never been able to find good evidence in favour of it, and believe that as a rule the rocks yield too slowly to produce any great elevation of temperature.

Spurious Cod-Liver Oil.—According to *Cosmos*, a manufacture of cod-liver oil has sprung up in Paris. The raw material is not the fresh liver of the cod, but the stale fish and other refuse of the Halles Centrales, the manufacturers, doubtless, thinking that any oil may serve if it be sufficiently nasty.

Abstracts of Papers, Lectures, etc.

LANCASHIRE AND CHESHIRE ANTIQUARIAN SOCIETY.

On October 6th the members of this Society visited the Geological Museum at Owens College, where they were addressed by Professor Boyd Dawkins, who said he wished to take the opportunity of pointing out the method of arrangement which had been adopted in the section of the museum which represented the history of the Tertiary world and its inhabitants, and which was the only portion of the museum which concerned them as students of the ancient history of man. At the first outlook they might fancy that the subject of archæology had no place whatever in a natural history museum. It seemed to him that the question was one which required some explanation. It was answered, in his own case at all events, by practical experience. He had found, in the course of his inquiry into the history of the earth, in dealing with the Tertiary period, that it is absolutely impossible to keep the history of man out of the later periods of the geological record. He had, therefore, been compelled to organise a portion of the museum in which man found himself recorded in his first coming on the earth, and also in various stages of progress in which he is represented by the implements which are found in various strata. Further than that, when he came to inquire into the history of the rocks themselves, he found that there were strata belonging to the period included in history. For that reason he had been compelled not only to deal with Palæolithic man as a fossil, and as truly a fossil as the Pleistocene mammals by which he was surrounded, but also to place in the museum a small collection of implements, ornaments, and weapons and other articles representing the state of civilisation in the Historic Period. Such then was his justification for putting anything of the nature of archæological specimens into the Tertiary section. He put them there because they form part of the ancient history of the earth. The Tertiary division of the history of the earth begins with the Eocene and ends with the Tertiary period, and the successive stages are marked by the various collections on the east side of the first floor of the museum. Drawing their attention to a few of the most important points which concerned them as students of the ancient condition of man, he referred to a group of animals and shells and a quantity of flint splinters found on the banks of the ancient Thames, at Crayford, in the neighbourhood of London, when the river wended its way on the one hand into Essex and on the other hand into Kent. Those bones and other materials gave them a picture of the life of the times. When they saw the tusks of elephants, the remains of the Irish elk, the bison, the ox, and other animals, all lying side by side, and when they saw along with them splinters of flints which have been struck off in the manufacture of flint instruments, they observed at once the surroundings under which man first of all made his appearance in Britain in the Pleistocene age. They would notice a small group of river shells in this period, among which was one species *(Corbicula fluminalis)* now only to be found in the Nile and other rivers of the South and the East. Next they came to the Palæolithic instruments of the river gravels, representing a primeval condition out of which mankind has been removed for incalculable ages. When he told them those instruments were found over the greater part of this country, the whole of France, over the whole of the borders of the Mediterranean, in Africa and in Europe, and Palestine, and when, further, exactly that type of instrument occurs also in India, he thought they would realise the interest which centres in implements which imply the same rude condition of barbarism over the whole of Europe west of the Rhine, over the whole of the Mediterranean region, as well as in the jungles and forests of India. Then came next the period of the Cave-Men. In the caverns were found the bones of the horse, the rhinoceros, the reindeer, the hippopotamus, all brought in by the hyenas; and in association with them were to be found a whole series of remains proving the existence of man in Yorkshire, Somerset, and Devonshire. Among these remains was the picture of a horse engraved on a polished bit of bone, which might be looked upon as the very earliest specimen of art which they had found in Britain. There were also photographs and sketches and casts of engravings and sculptures from the foreign caves. In the prehistoric period they would see an excellent collection of polished stone axes from Greece, about which he was amused to read a short time ago, that none had ever been found in that part of the world. Those that were in the museum were collected by Mr. Finlay, a well-known resident in Athens. There was also a collection of things from Switzerland, which proved that the arts of spinning and weaving, of husbandry, and of pottery making were introduced into Europe in the Neolithic age. They would also see evidence of the introduction of the domestic animals, the sheep, goats, pigs, oxen, horses and dogs, all coming in with the primeval Neolithic farmer. In another part of the case they would see proof that the Neolithic peoples were acquainted with the art of mining, in a collection which he had obtained from an ancient flint mine in Sussex. Not only that, but they would see a few human skeletons of the people who introduced these arts into Europe, the people who are living to this day in the shape of the small dark Welsh, the Irish, and the small dark Highlander. He might say further that some of those people are to be found now in Yorkshire, in Derbyshire, and he had no doubt that the blood of those people might be found in the veins of some of those around him that afternoon. The remainder of these are found in the alluvia in the deposits of the ancient rivers, and in the peat bogs. as well as in tombs. Going a stage further, they came to the Bronze age, in which were to be found samples of the domestic animals. There was a very curious thing to be noted in the group of human skulls found along with them. Some two years ago Mr. H. D. Pochin, a well-known resident of Salford, asked him (Professor Dawkins) to undertake the exploration of a cavern called Gop, crowning a hill south of the Vale of Clywdd. In a sepulchral cavern close by they found a stone chamber full of human remains. The skulls were of the long type belonging to the small dark Neolithic race he had referred to, but there was one skull which belonged to the conquering race who introduced bronze into this country, and who were distinguishable from the Celt, being altogether a bigger and stouter race than the small dark Welsh. So that they had two distinct types associated together in the sepulchre belonging to the Bronze age. They had also other examples of the Bronze age. He took this opportunity of calling the attention of the Lancashire and Cheshire Antiquarian Society to the extreme poverty of bronze implements in the museum. He should welcome any additions to this part of the collection, and be exceedingly grateful for any help that he could get in filling this blank. Passing from the prehistoric, they now came to the collection which represents the historic period; first and foremost among which they found an interesting number of things from Egypt. They had a most remarkably preserved group of mummies, found recently by Mr. Flinders Petrie, and presented to the Museum by Mr. Jesse Haworth. Two are of a period which ranges from about Anno Domini to 200 years before Christ; while the third is of an early Greek type, which was found in Egypt, and dates from A.D. to 150 A.D. The interest of the last was exceedingly great from an artistic point of view. On the head of the mummy was a most excellently preserved portrait of the occupant. The preservation was simply marvellous; the art singularly excellent; and the discovery altogether an important one. All these three mummies had been found in a deposit of sand near the ancient city of Arsinoe, and they represented burials which took place from time to time of the citizens of that great city. They would also see in the Historic rooms specimens from Babylonia, Rome, Australia, the South Sea Islands, Mexico, and North America. In conclusion, Professor Boyd Dawkins said that of course, naturally after the examination of ancient history of the earth, when they had closed their record at the historic period, they there had full scope for the working out of the history of animals and the plants to which the rest of that part of the museum was devoted. They had, in other words, a philosophical arrangement showing the gradual evolution of things in the Tertiary ages which is still going on, and which finds expression in the history of the present surface of the earth and of the living animals, including man, and of the living plants.

NATURAL HISTORY SOCIETY OF GLASGOW.

THE first meeting of the winter session was held on Tuesday, 25th September, Mr. P. Ewing, Vice-President, in the chair.

Mr. D. Pearson exhibited a living specimen of the Australian piping-crow (*Gymnorhinus tibicen*). The bird belongs to an Australasian group, readily distinguishable from the true *Corvidæ* by the peculiar form of the nostrils, which are long, narrow, sunk in the substance of the bill, and usually quite exposed. The black and white plumage is rather handsome, and bears some resemblance to that of the magpie. The piping notes of the bird are not unmusical, and compare favourably with the song of most others of its tribe. In captivity it displays excellent powers of mimicry.

Mr. J. Steel showed a glass jar with sea water, containing hundreds of the larval form of the common shore crab (*Carcinus mœnas*), and remarked that in their early stage of development these crustacea are pelagic rather than littoral as regards their haunts.

Mr. H. McCulloch exhibited a specimen of *Goliathus cacicus*, a large and beautifully-coloured beetle, from Old Calabar, Western Africa.

Mr. J. J. F. X. King showed a series of specimens of *Œcetis notata*, a neuropteron recently captured by him on the Liffey, near Dublin. He stated that the insect has occurred in various parts of England, but is new to the Irish fauna.

Mr. D. A. Boyd made some remarks on *Smynthurus* and *Papirius*, two genera of Collembola, or "spring-tails," and exhibited a series of specimens of these insects taken near West Hilbride, Ayrshire. He also showed fertile specimens of *Bartramia Halleriana* and *Fontinalis squamosa*, two mosses from the neighbourhood of Largs.

Mr. T. King, Vice-President, showed an extensive collection of fungi from the district around Glasgow, including *Agaricus scobinaceus*, *A. platyphyllus*, and other species of more or less rarity.

Mr. W. Stewart exhibited five species of *Peziza*, including two apparently new to the British flora.

Rev. A. S. Wilson, M.A., B.Sc., read a paper on the "Dispersion of Seeds and Spores," in which he described the various natural appliances for insuring the suitable distribution of these objects, and the means by which the dispersion is aided or effected. The paper was illustrated with diagrams and specimens.

MANCHESTER GEOLOGICAL SOCIETY.

THE annual meeting was held on October 9th, Mr. Joseph Dickinson, the President, in the chair.

Mr. Mark Stirrup, Honorary Secretary, read the annual report of the Council. In it they state that as this was the fiftieth year of the Society's existence it was thought desirable to review its history as recorded in the minutes, books, and publications. The Society was founded by a resolution passed at a meeting of the friends of geological science held on October 15th, 1838, at the York Hotel, King Street, now the site of the Manchester and County Bank. This meeting was presided over by Lord Francis Egerton, afterwards the first Earl of Ellesmere, and the objects of the Society's foundation were then declared to be: "To investigate the mineral and organic remains of the earth, to inquire into statistics, machinery, maps, models, and mining records; to publish the transactions of the Society, with suitable illustrations, and to form a museum to be opened gratuitously to the public." The first annual meeting was held in the rooms of the Royal Institution, Mosley Street, on January 17th, 1839, under the presidency of James Heywood, F.R.S., who, with about four other members, were still living. At the end of this year Mr. Heywood offered the greater part of his house in Mosley Street, at the corner of St. Peter's Square (now the Clarendon Club), and the Society went thereto. The rapidly increasing collection of fossils was also removed there, and a beginning was made in arranging the names and specimens. The British Association visited Manchester for the first time in 1842, and materially assisted the Society by a grant of £100 from its funds towards arranging its collection. Shortly after this an arrangement was entered into between the Society and the Natural History Society for the amalgamation of their geological collections. The amalgamated collection was thenceforward housed at the Museum in Peter Street (where the Society also met), until in the year 1873, by general agreement, the whole collection was transferred to the Owens College, under stipulations as to maintenance and care, the free admission of members and of the public on certain days, and that the College should provide a fitting building for the museum. By providing accommodation for the united collection in the new building in Oxford Road, the Owens College had admirably redeemed its pledge. The collection, rearranged and renamed by Professor Dawkins and his assistants, was now opened in a lofty, spacious, and well-lighted room, ninety feet in length, with the minerals immediately adjoining, accessible in every part. From the year 1873, when the present premises were secured, the Society had made a continuously steady advance in membership and otherwise, and many valuable papers had been read. The revenue of the Society had been carefully looked after, and the reserve fund now stood at over £1,000.

Coming to the ordinary report, the Council had pleasure in stating that the Society showed no signs of decadence or loss of vitality, but rather seemed to have witnessed a renewal of its vigorous youth in the more than average number and quality of the papers that have been brought before the meetings. The papers, twenty-nine in number, had been varied in character, and some of the subjects which had been discussed were especially noteworthy as matters affecting large commercial interests, and in some degree our national prosperity. In accordance with a request in the last annual report, that the Society should take up some definite work in connection with one or other of the committees of the British Association, the Council were pleased to state that a beginning had been made by a few of the members in collecting information as to the distribution of erratic blocks in Lancashire and adjoining counties. A portion of that information had already been embodied in a paper read before the Society. The number of members on the roll, 215 in all, showed a slight diminution. During the year nine new members had been added to the list, nine had resigned, and four had died.

The following officers were elected for the coming year:—President, Mr. John Knowles; Vice-Presidents, Messrs. H. Bramall, J. S. Burrows, G. Peace, and R. Winstanley; Council, Messrs. Barrett, C. Newton, G. H. Peace, J. Ratcliffe, J. Tonge, H. A. Woodman, R. T. Burnett, J. Wilde, C. Pilkington, and H. Saint; Treasurer, Mr. H. M. Ormerod; Hon. Secretaries, Mr. Mark Stirrup, F.G.S., and Mr. G. H. Hollingworth; Auditors, Mr. Clegg Livesey and Mr. A. Pilkington.

MANCHESTER CONCHOLOGICAL SOCIETY.

At the monthly meeting held on October 4th, Mr. Thomas Rogers exhibited specimens of *Limax flavus* and eggs—a slug generally found in cellars, but occurring abundantly in yards near the river Irk, behind the gas works in Rochdale Road. The indifference of this species to the impurities of the atmosphere of a town is one of the few exceptions to the habitats of the Land Mollusca generally. He also showed a fine living specimen of *Helix aspersa*, which had been picked up in Smithfield Market from amongst some artichokes. The specimen when first obtained was quite young, and little larger than a pea, but had since grown into the large size exhibited. Mr. Rogers thought it might have been possibly imported with vegetable produce from Algiers or some Mediterranean port, as the specimen compared favourably with some large shells of the same species which he exhibited from the interior of Morocco.

Mr. R. Standen exhibited a beautiful and well-mounted series of the "darts" of various species of Helix, which he had obtained by dissection of the animals. He drew special attention to the marked distinction, both in size and structure, between the "darts" of *Helix nemoralis* and *Helix hortensis*, as showing beyond doubt that these are really distinct species, a fact now generally accepted by conchologists, although Jeffreys and others considered *hortensis* merely a variety of *nemoralis*. The exquisite appearance of these curious crystalline bodies elicited deserved admiration, showing as they do very varied and elegant forms. The "dart" is a straight or curved, sometimes slightly twisted, tubular shaft of carbonate of lime, tapering to a fine, solid, transparent point above. It is only found in mature shells. After much speculation as to its use, the general opinion now seems to be that it serves an important part in pairing. It has been ascertained that we have in the British Isles, four species of *Helix* which carry two darts, and eleven species which have but one. Two species of Zonites also possess darts.

SOUTH LONDON ENTOMOLOGICAL AND NATURAL HISTORY SOCIETY.

This active and energetic society held its annual Exhibition at the "Bridge House" Hotel, London Bridge, on October 17th and 18th. The specimens brought together illustrated almost every department of natural history, and we feel ourselves well within the mark in saying that a display so beautiful, so varied, and, above all, so instructive, has certainly never been previously brought together on the south bank of the Thames.

The Exhibition occupied three large rooms. In the Nelson Room, on the first floor, we noticed a very extensive assortment of microscopes, microscopic objects, and apparatus. So richly stocked, in fact, was this department that an entire day would have been requisite to inspect everything worth seeing. Next, we noticed a display of birds, reptiles, fishes, and insects; a collection of rocks and fossils, illustrative of the geology of the South-East of England, contributed by Messrs. T. Leighton, F. D. Power, and T. D. Russell. Mr. Livesey contributed some good osteological specimens, whilst Miss M. E. Adkin, Miss F. Billups, and Messrs. Pearce and Step had furnished a good botanical collection. Lastly, that indefatigable naturalist, Mr. J. T. Carrington, and Mr. E. Step had brought together an assortment of fungi —a department too much neglected. In the Wellington Room, on Wednesday, 17th, Mr. R. May delivered two lectures, one on "The Wonders of Minute Vegetable and Animal Life," at 8 p.m., and one on "Curious Houses and Queer Tenants," at 9.30 p.m.

On Thursday evening, at 7 p.m., in the same room, the Sciopticon Company gave a beautiful exhibition of photo-micrographic slides, whilst at 8.15 Mr. G. Day gave a further display of micro-photographic slides illustrative of entomology, geology, etc.

The main display, however, was in the ball-room on the third floor, which was converted into a well-stocked museum. The assortment of birds, birds' eggs, and nests was decidedly good. As regards the display of insects, the Lepidoptera were evidently the favourites. We particularly notice a specimen of *Daphnis nerii* caught at Poplar. Odeoptera played but a subordinate part, though the collection of British beetles furnished by the President, Mr. T. R. Billups, comprised nearly all the species known to occur in Britain. The collections of Mr. J. H. Leech and W. West were also well deserving of admiration.

As for the "neglected orders," a collection of Neuroptera had been furnished by Mr. R. McLachlan, whilst assortments of Hymenoptera, Hemiptera, and Diptera were shown by Messrs. Billups and Verrall. A collection of Mollusca was sent in by Mr. F. G. Fenn, and a nice selection of corals and sponges by Mr. W. Manger.

We can only briefly glance at the specimens illustrative of pathology sent by Mr. W. Roots, and the collection of plants collected by Mr. W. A. Pearce in a journey from San Diego to the Sonora Pass, California.

With the entire display we were not merely satisfied, but delighted; and we hope the immense trouble taken by the committee and their friends will redound to the benefit of the society. It cannot be too widely known that one of its objects is to afford to youths who have a taste for Natural History that practical guidance which books alone fail to impart.

MANCHESTER MICROSCOPICAL SOCIETY.—The members of this Society held a conversazione on October 11th. Amongst the exhibits the micro-photographs taken by Mr. E. Ward attracted much attention. Mr. E. P. Quinn delivered a short and interesting lecture on vegetable traps, and Mr. J. A. Furnivel exhibited with a lantern microscope a number of prepared slides.

EDINBURGH ASSOCIATION OF SCIENCE AND ARTS.—At the meeting held on October 15th, Mr. J. M. Turnbull was elected President, and Messrs. T. R. Proctor and W. Bruce Vice-Presidents for the ensuing session. The retiring President, Mr. J. Melrose, said that the Association numbered 291 members.

RECENT INVENTIONS.

The following list has been compiled especially for the SCIENTIFIC NEWS *by Messrs.* W. P. THOMPSON *and* BOULT, *Patent Agents, of* 234, *High Holborn, London, W.C.; Newcastle Chambers, Angel Row, Nottingham; Ducie Buildings, Bank Street, Manchester; and* 6, *Lord Street, Liverpool.*

RACKETS.—Mr. W. Hawcridge has patented a press for lawn tennis racket. The object is to prevent rackets from twisting and for keeping them true. Two triangular pieces of wood are used, connected at each angle by screws adapted to allow the racket to pass between them at the base, and to be pressed between them by tightening the screws.

ELECTRICITY.—Mr. S. Joyce, junr., has patented the use of electricity as a source of explosive power. The electric explosive consists of a vessel wholly or partly filled with water, which is heated by the passage of an electric current through a coil of wire inserted in it; steam is thus generated, and the vessel exploded when sufficient pressure has been attained. Other fluids, such as dilute sulphuric acid, may be used instead of water.

CALENDAR.—An improved calendar has been patented by Messrs. B. Weeksler and M. E. Becker, of 128, Queen Victoria Street, and the object thereof is to enable the spectator to trace the day of the week of any date given. It consists of two distinct round pieces, the one rotating within the other. Upon the inner are inscribed the years and dates of the months and on the outer the days of the week and the names of the months. In operation the inner dial is moved so that the year in question is immediately opposite the given month, and the day appearing next the date is that required.

CLUBS.—Mr. W. A. Woof has patented an Indian club. The object is to so construct Indian clubs that their weight may be altered and adjusted to suit the party using them. Externally the shape of the club is as usual, but has its large end bored to receive a screw-bolt and movable metallic weights. The weights are of any suitable thickness, and have a hole in them to allow of the passage of the screw-bolt. When the requisite number of weights have been inserted, the screw is passed through them and screwed into a bush, until the head of the screw is firmly pressed against the outer weight.

CONTROLLING COCKS BY ELECTRICITY.—Mr. H. R. Fisher, of Waterloo Road, has patented an invention for controlling cocks and valves by electricity. A cap is provided which fits on the square shoulder of the plug of the cock, and projecting therefrom is a horizontal lever weighted to balance the resistance of the cock. An electro magnet is placed near the longer end, with its armature supporting the lever. When the circuit is closed, the armature is attracted, and the lever falls; the weight thereon (being loose upon it) slides down so as to increase the leverage, and the cock is opened.

PRESERVING MEAT.—Mr. Benjamin Willcox, of 47, Lincoln's Inn Fields, has been granted a patent for a process for preserving meat and other foods. (A communication from Mr. H. Lalyzer, M.D., of Baltimore, U.S.A.) In this process the pieces of meat are enclosed in an envelope of animal membrane, subjected to the heat of steam (to contract the bulk and destroy the organisms), are coated with plaster of Paris, and then placed in a bath of heated vaseline and paraffin, and finally wrapped with paper tinfoil or other material. By this process the article is made absolutely proof against attacks by germs of any kind.

PRESERVING SEEDS.—Messrs. P. L. Quarante and C. E. Le Revert have patented means for preserving seeds and plants from the action of parasites and hastening the germination and fertilization of seeds. To protect seeds from parasites when sown in the ground, they should be steeped in antiseptic and fertilizing liquids, with which young plants should be watered. The liquid for these purposes is composed as follows:—Acetate of aluminium, 15 parts; acetate of lead, 70 parts; Iceland spar or carbonate of lime, 15 parts. These matters are mixed and dissolved in water, and then used as stated. By this method the germination of the seed is also facilitated.

ELECTRICAL SWITCHES.—Messrs. F. L. Rawson and Mr. White have patented an electrical switch. It consists of a base of suitable material on which are fixed two contact plates. The connection between these arms is made by a switch-arm, consisting of several thin strips of metal placed one upon another and bent over at their ends, so that they press edgeways upon the contact plates. The switch-arm is attached to a handle and centre pin, which forms the centre upon which the switch-arm turns. The lower end of the pin carries a nut, and between this and the underside of the switch base is placed a washer, giving the necessary pressure on the contact plates. To secure a quick break a spring is provided which comes into action and presses on a spring-arm just before the switch-arm leaves the contact plates, and quickly drives the switch-arm rapidly from the same.

ANNOUNCEMENTS.

THE INSTITUTION OF CIVIL ENGINEERS.—The Council invites original communications on the subjects included in the following list, as well as on any other questions of professional interest. This list is to be taken merely as suggestive and not in any sense as exhaustive. For approved papers the Council has the power to award premiums, arising out of special funds bequeathed for the purpose, the particulars of which are as under:—

1. The Telford Fund, left "in trust, the interest to be expended in annual premiums, under the direction of the Council." This bequest (with accumulations of dividends) produces £260 annually.

2. The Manby Donation, of the value of about £10 a year, given "to form a fund for an annual premium or premiums for papers read at the meetings."

3. The Miller Fund, bequeathed by the testator "for the purpose of forming a fund for providing premiums or prizes for the students of the said institution, upon the principle of the 'Telford Fund.'" This fund (with accumulations of dividends) realises £150 per annum. Out of this fund the Council has established a scholarship—called "The Miller Scholarship of the Institution of Civil Engineers"—and is prepared to award one such scholarship, not exceeding £40 in value, each year, and tenable for three years.

4. The Howard Bequest, directed by the testator to be applied "for the purpose of presenting periodically a prize or medal to the author of a treatise on any of the uses or properties of iron or to the inventor of some new and valuable process relating thereto, such author or inventor being a member, graduate, or associate of the said Institution. The annual income amounts to nearly £16. It has been arranged to award this prize every five years, commencing from 1877. The next award will therefore be made in 1892.

The Council will not make any award unless a communication of adequate merit is received, but will give more than one premium if there are several deserving memoirs on the same subject. In the adjudication of the premiums no distinction will be made between essays received from members of the Institution or strangers, whether natives or foreigners, except in the cases of the Miller and the Howard bequests, which are limited by the donors.

LIST.

1. The utilisation of unused sources of power in Nature —such as the tides, the radiant heat of the sun, etc.
2. Standard specifications for the materials used in the construction of engineering works.
3. The influence of sea water upon Portland cement, mortar, and concrete.
4. The construction, ventilation, and working, of railway tunnels of great length.
5. Description of any new or peculiar type of mountain railway for very steep gradients.
6. Recent improvements in cable tramways.
7. The value, with respect to the safety and durability of metallic bridges, of (*a*) increase in the weight of the structure, by the choice of other than the latest design; (*b*) increase in the dead load, by the adoption of a heavy description of flooring, with or without the addition of concrete or ballast
8. The painting and preservation of metals, woods, etc.
9. Recent examples of hydraulic lift graving docks.
10. Forms and construction of masonry dams for reservoirs.
11. The cleaning and deepening of drainage and irrigation canals by mechanical means.
12. On the sale of water by measure.
13. Descriptions of mining machinery of improved design.
14. Gold quartz reduction and amalgamation—description of the various machines, and of their method of working.
15. The physical properties of metals under test.
16. The working strength of iron and steel as affected by (*a*) the amplitude; (*b*) the frequency; and (*c*) the time rate of the stress variations.
17. The present position of the manufacture of steel—its defects, and suggestions for its improvement.
18. The effect upon basic steel of (*a*) chromium; (*b*) aluminium; and (*c*) tungsten.
19. The properties of bronzes and other alloys.
20. Researches on the actual working limits of stress in machinery or structures under known conditions of variation of loading.
21. The corrosion of metal structures, and the best means of preserving them.
22. The effect of wind upon structures, as influenced by (*a*) their superficial area; (*b*) the form or position of the exposed surfaces; (*c*) the shelter of adjacent bodies; and (*d*) the dynamic action of sudden gusts.
23. On forging by hydraulic pressure, and casting under the same.
24. The construction of the working parts of steam engines, in relation to the high pressures and temperatures now becoming general.
25. The practical limit to the working pressure of steam in marine boilers.
26. The various systems of forced draught in boilers, with the economical results obtained.
27. The most recent types of (*a*) mail steamers; (*b*) cargo steamers; and (*c*) war ships.
28. On modern experience in screw propulsion, comprising the comparative efficiency of propellers of large diameter, and of smaller ones deeply immersed, and of the influence of form.
29. On the highest speeds attained and attainable on railways, having reference to gradients, curves, and the locomotives employed.
30. The application of the compound principle to locomotive and to portable engines.
31. Mechanical traction on common roads.
32. The petroleum engine and its applications.
33. The distribution of power by compressed air or by vacuum, and the construction of machines to be worked by compressed air or by vacuum.
34. Hydraulic rotative motors for high pressures.
35. The means of governing and economising high pressure fluid in hydraulic cranes, engines, etc.
36. The construction and working of windmills suitable for raising water for the supply of villages and isolated houses.
37. The best combined system of warming, ventilating and lighting large buildings.
38. The transmission of steam underground in the United States, with the results obtained.
39. The plant used in the execution of important engineering works
40. Tools used in the building of iron and steel ships, and in the construction of boilers.
41. The construction and working of friction-brake dynamometers.
42. Steam cultivation by digging and by ploughing.
43. The generation of alternating currents in dynamo electric machines, and their utilisation for lighting and power purposes.
44. Electric meters for recording the consumption of electrical energy.
45. The construction and maintenance of secondary batteries.
46. Central station electric lighting.
47. The application of electricity to the working of street tramways and of railways.
48. The application of electricity to the working of cranes, pumps, tools, etc.
49. The application of electricity to smelting and metallurgical operations.
50. The application of electricity to the purification of water and of sewage.
51. The purification of copper, and the reduction of copper ores by electrolytic processes.
52. Contributions to the bibliography of special branches of engineering.

For further particulars apply to the Secretary, The Institution of Civil Engineers, 25, Great George Street, Westminster, S.W.

DIARY FOR NEXT WEEK.

Monday, Oct. 29.—Birkenhead Literary and Scientific Society, at 8 p.m.—*Some Psychical Phenomena*, by Rev. A. Sloman.

Thursday, Nov. 1.—Chemical Society, Burlington House, at 8 p.m. Gresham College, Basinghall Street, at 6 p.m. —*Lecture on Law*, by Dr. J. T. Abdy.

Friday, Nov. 2.—Gresham College, Basinghall Street, at 6 p.m. —*Lecture on Law*, by Dr. J. T. Abdy.
Greenock Philosophical Society, Watt Institution, at 8.15 p.m.—*How Jupiter and Venus caused the Great Ice Age*, by Sir R. S. Ball, F.R.S.

SELECTED BOOKS.

On the Senses, Instincts, and Intelligence of Animals. With Special Reference to Insects. By Sir John Lubbock, Bart., M.P. With 100 illustrations. London : Kegan Paul, Trench, and Co. Price 5s.

Elementary Commercial Geography. A Sketch of the Commodities and Countries of the World. By H. R. Mill, F.R.S.E., Lecturer on Commercial Geography in the Heriot Watt College, Edinburgh. London : C. J. Clay and Sons. Price 1s.

Planetary and Stellar Studies, or Short Papers on the Planets, Stars, and Nebulæ. By J. Ellard Gore, F.R.A.S. London : Roper and Drowley.

An Elementary Treatise on Geometrical Optics. By R. S. Heath, M.A., Professor of Mathematics in Mason Science College, Birmingham. London : C. J. Clay and Sons. Price 5s.

A Class-Book of Elementary Chemistry. By W. W. Fisher, M.A., Demonstrator of Chemistry, Oxford. London : Clarendon Press. Price 4s. 6d.

The Metallurgy of Gold. A Practical Treatise on the Metallurgical Treatment of Gold-bearing Ores, including the processes of Concentration and Chlorination, and the Assaying and Refining of Gold. By M. Eissler, formerly Assistant Assayer of the U.S. Mint, San Francisco. With ninety illustrations. London : Crosby Lockwood and Son. Price 7s. 6d.

Kirke's Handbook of Physiology. Twelfth edition. Thoroughly revised and edited by W. Morrant Baker, F.R.C.S., and Vincent Dormer Harris, M.D. London : J. Murray. Price 14s.

The Principles of Agricultural Practice as an Instructional Subject. By J. Wrightson, M.R.A.C., F.C.S., etc., Professor of Agriculture in the Normal School of Science and Royal School of Mines, etc. With Geological Map. London : Chapman and Hall, Limited. Price 5s.

NOTICES.

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METEOROLOGICAL RETURNS

for the ten weeks ending on Monday, Oct. 15th, 1888. Specially prepared for SCIENTIFIC NEWS from official reports.

	Mean Temperature.	Rainfall.	Duration of Sunshine.
Scotland, East	51·0 degs., being 2·1 degs. below average.	3·7 ins., being 3·8 ins. below average.	266 hrs., being 24 hrs. above average
England, N.E.	52·0 ,, ,, 2·6 ,, ,, ,,	3·6 ,, ,, 2·8 ,, ,, ,,	268 ,, ,, 3 ,, below ,,
England, East	53·9 ,, ,, 3·3 ,, ,, ,,	3·9 ,, ,, 2·2 ,, ,, ,,	327 ,, ,, 4 ,, above ,,
Midlands ...	52·8 ,, ,, 3·7 ,, ,, ,,	3·6 ,, ,, 3·4 ,, ,, ,,	314 ,, ,, 4 ,, ,, ,,
England, South	55·0 ,, ,, 2·8 ,, ,, ,,	3·4 ,, ,, 3·0 ,, ,, ,,	362 ,, ,, 31 ,, ,, ,,
Scotland, West	51·8 ,, ,, 2·1 ,, ,, ,,	5·4 ,, ,, 5·6 ,, ,, ,,	279 ,, ,, 16 ,, below ,,
England, N.W.	52·9 ,, ,, 3·2 ,, ,, ,,	4·8 ,, ,, 3·8 ,, ,, ,,	299 ,, ,, 8 ,, above ,,
England, S.W.	54·0 ,, ,, 3·0 ,, ,, ,,	5·7 ,, ,, 4·3 ,, ,, ,,	369 ,, ,, 2 ,, ,, ,,
Ireland, North	53·4 ,, ,, 2·4 ,, ,, ,,	5·5 ,, ,, 2·6 ,, ,, ,,	244 ,, ,, 12 ,, below ,,
Ireland, South	53·7 ,, ,, 2·5 ,, ,, ,,	4·3 ,, ,, 4·2 ,, ,, ,,	324 ,, ,, 7 ,, above ,,
The Kingdom...	53·1 ,, ,, 2·8 ,, ,, ,,	4·4 ,, ,, 3·6 ,, ,, ,,	305 ,, ,, 6 ,, ,, ,,

Scientific News

FOR GENERAL READERS.

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CONTENTS.

SCIENTIFIC TABLE TALK.

By W. Mattieu Williams, F.R.A.S., F.C.S.

The *Saturday Review* commences an article on the subject of "Adulteration" as follows: "Generally speaking, nothing which we eat or drink is what it seems; everything is unreal and what it ought not to be, from marmalade, in the composition of which the common turnip plays no insignificant part," etc., etc.

This statement about turnips in marmalade is so frequently repeated, and is actually believed by so many, that a demonstrative contradiction is demanded. Some years ago I tried the experiment of mixing "no insignificant" proportion of turnip pulp with some home-made marmalade, first using equal weights of turnip and orange, and found the result most nauseous, the rank turnip flavour growing worse and worse the longer it was kept. I then tried two of orange to one of turnip, then three to one, and finally only $\frac{1}{16}$ of turnip—that is, one ounce to the pound—and still the turnip flavour was so evident, both to taste and smell, that such a mixture would be utterly unsaleable. This experiment may be easily repeated by anybody.

A great number of other alleged adulterations, when practically tested, prove to be equally imaginary. That of iron filings in tea was very popular some years ago, definite assertions as to the quantity thus added being made, commonly about 5 per cent. Grocers were convicted and fined for selling tea containing such quantity. I wrote to the *Chemical News* a letter which was published November 21st, 1873, working out the figures as follows. The price of the cheap teas said to be thus adulterated does not exceed 4d. to 6d. per pound in China. If the Chinaman obtains iron filings at 2d. per pound, his gain by such adulteration would amount to about $\frac{1}{10}$ of a penny per pound, or still less when the cost of labour in mixing is deducted. The total deliveries of black tea into the port of London alone amounted at the time to 160 millions of pounds, of which 140 millions came from China. Adding those to tea-drinking Russia, to America, and the British Colonies, the total exports from China amounted to 400 to 500 millions of pounds of tea per annum. If only 100 millions of pounds were thus adulterated (the iron was found in all samples of black tea) five millions of pounds of iron filings would be required annually. How could the Chinaman obtain this quantity of *filings?* It should be noted that only very fine filings would answer the purpose, as coarse filings would shake down to the bottom of the chests.

If the adulteration was perpetrated in England, where is the market? Where are the waggon-loads of iron filings that would be demanded? Who collects them? The quantity produced in each workshop being so small, the collecting of a million of pounds would be a big business. As a matter of fact no market for iron filings exists, except for small quantities used by firework-makers and some other trifling purposes. Nearly all are swept away.

But there is iron in tea; it has been found even in the leaves of plants grown under glass at Kew. "The Yellow River" of China is so called because it is tinted with the ochreous earth which constitutes the soil on which most of the Chinese tea is grown, and tea-leaves gathered in dusty weather are liable to be slightly coated with the ferruginous dust from the soil on which they grow, in addition to containing a little iron, which they naturally absorb from the soil. Upon this basis was erected the whole fabric of supposed adulteration. As I showed in the letter above referred to, the colour of *black* tea is due to the combination of some of the iron it contains with the tanno-gallic acid it also contains. This tanno-gallate of iron is the colouring matter of ordinary black ink. In the dried tea-leaf it exists in an insoluble form.

The idea of substituting sloe leaves in this country, is equally absurd. Where are the sloe plantations? If gathered from the hedgerows, where the wild sloe may be found, who are the gatherers? They should be as numerous and as evident as hop-pickers.

Within my recollection it was confidently asserted that brown sugar was adulterated with sand. Common sense should have refuted this at once, seeing that every cup of tea or coffee sweetened with such sugar would effect a quantitative analysis by displaying a gritty, insoluble residue at the bottom of the cup. Plum puddings or any other solid product of cookery in which sugar was used would be utterly uneatable, on account of the painful effect of attempting to masticate silicious particles.

Doubtless there are some adulterations practised. I have recently detected one in moist sugar, viz., common salt, which is not added for its own sake, but for the water which it causes to adhere to the sugar. It is not added by the usual victim of the Adulteration Act, the retail grocer, but by the manufacturer, and if I am not mistaken, it is done by adding sea-water or brine to the syrup before crystallisation.

Falsification is more prevalent than adulteration, and it is usually perpetrated on the most costly articles, such as high-class wines—so called and paid for—high-priced cigars, etc. Common "Italian red," diluted Catalan, and other very cheap sound ordinary wines are, by skilful manipulation with certain ethers and other flavouring ingredients, endowed with fancy bouquets, and the rest is done by a transmutation of labels according to the varying demands for fancy vintages. The higher the price the greater the temptation. Those who imagine that by paying a high price they are secure from such imposture are the most abundantly fooled. The chateaus that give their names to these choice wines have usually but small vineyards, producing in some cases not more than two or three per cent. of the quantity of wine that is labelled with their names.

There is another kind of adulteration, of which we hear very little, and which is not punishable under the Act of Parliament, viz., the adulteration of silk. About thirty years ago, when at the Midland Institute, I made a series of experiments on aniline dyes for a leading house in the silk-dyeing business. I went through the works at Coventry with the head of the firm, and saw various processes of "weighting" in operation. He expressed his own disgust at the practice, and told me that he commonly received samples of "boiled silk" (that is, the raw silk cleansed from its natural gum by boiling in potash), with orders to return sixty ounces to the pound when dyed. This was especially the case with black silks.

The forty-four ounces consisted of salts of tin, lead, etc., attached to the fibres by mucilaginous compounds. These metallic salts become more or less crystalline when the silk is dry, and cut through the modicum of actual silk wherever folds occur. Ladies know all about the facts of such cutting, though perhaps not of their cause. I have since learned that the progress of applied science has enabled the dyers now to return seventy ounces to the pound.

"China sewings," *i.e.*, the white silk used for sewing the button-holes of white waistcoats, when these were fashionable, were largely loaded with acetate of lead—so much so that it was easily detected by its sweet taste. Sempstresses employed on such button-hole work have suffered from lead colic, due to biting the ends of such silk in threading their needles.

THE RESPIRATION OF BATS DURING THEIR WINTER SLEEP.

If we disregard the earlier investigations of Gesner and Buffon, Saissy was probably the first who examined hybernating animals. He proved that in bats respiration became less frequent, and he even conjectured that in this condition they could support life in an atmosphere devoid of oxygen.

Marshall Hall examined a hybernating bat placed under a glass bell. He could not determine any absorption of gas during an interval of ten hours, whilst the same animal when awake expired in the same time 13 cubic centimetres of carbonic acid. Another bat consumed in sixty hours only 10 cubic centimetres of oxygen, whilst when awake it absorbed the same quantity in one hour. He found the temperature of the animal higher by 2 to 3 degs. Cent. than that of the surrounding atmosphere. According to Regnault and Reiset, the marmot, in its deepest winter sleep, consumes only $\frac{1}{30}$ of the oxygen which it would require in the same time when awake. Valentin, in his numerous experiments on hedgehogs and marmots, found still lower values. Such animals, however, cannot bear the total absence of oxygen, though they can live in an atmosphere containing 10 per cent. of carbonic acid and 5 per cent. of oxygen. The experiments of Horwath on the respiration of the pouched marmot (*Spermophilus citillus*) led to similar results, and Voit found that the marmot stores up oxygen during hybernation.

The more recent researches of Delsaux, communicated in the *Naturforscher* and in the *Archives de Biologie*, were made on the long-eared bat (*Plecotus auritus*) and the common bat (*Vespertilio murinus*). These animals were obtained from the caverns of Maestricht, where they may be found during the winter in thousands, at an average temperature of 6·7 degs. Cent., their bodily warmth being on the mean 7·13 degs. Cent. The animals were kept in the author's laboratory in the dark, and at a temperature of 7 to 8 degs. Cent. Each was kept in a separate cylinder, so that they might not disturb one another.

The respiratory rhythm during the winter sleep is peculiar. In the bats sleeping in the caverns no respiratory movement can be perceived often for a long time. In the laboratory, after long intervals, which may last for fifteen minutes, there occurs a series of very superficial respirations. Noise and light do not affect the breathing, but the slightest touch or agitation occasions at once a series of respiratory movements, followed, however, by long pauses of breathing if the animals are not further disturbed. If the bats are aroused from their sleep their temperature rises suddenly. The position, whether the animal is hanging—its natural attitude when asleep—or lying horizontally, seems to have no effect on the breathing. If the air be exhausted down to a pressure of 50 millimetres of mercury, the bat suffers from asphyxia, but recovers on the re-admission of air.

A Plecotus, which had been kept for half an hour in a cylinder cooled down to 21 degs. Cent., recovered and breathed, although the respiratory movements had previously entirely ceased. Horwath had observed that the hearts of hybernating animals still show regular pulsations, even if their blood has cooled down to + 4 degs. Cent. The animals experimented upon exhaled hourly per kilogramme of their weight 57·3 to 61 milligrammes of carbonic acid at +7·5 degs. to 8 degs. Cent., but only 39·4 to 44·6 kilogrammes at 0 degs. (freezing point). Thus, as in the cold-blooded animals, a reduction of temperature naturally decreases the excretion of carbonic acid.

CREMATION.—We learn from *Cosmos* that cremation has been formally interdicted by the Pope as a "condemnable abuse."

THE SCALY AMPHIBIA OF THE PLAUEN GLEN NEAR DRESDEN.

THE subjoined figures, for which we are indebted to the courtesy of a German contemporary, the *Illustrirte Zeitung*, give a good idea of the structure of a very interesting group of extinct animals.

The teachings of Darwin served as a challenge to geologists to find out the supposed intermediate forms which link together organisms now living and seemingly quite unconnected. What the zoologist had prophetically foreseen, taking his stand upon embryological and morphological researches, the geologist has to seek out in the strata of the earth, furnishing in this manner new and irrefutable evidence of the unity of the organic world, and proving that animals are not the outcome of desultory, special creation, but have advanced in gradual stages to higher and higher differentiation.

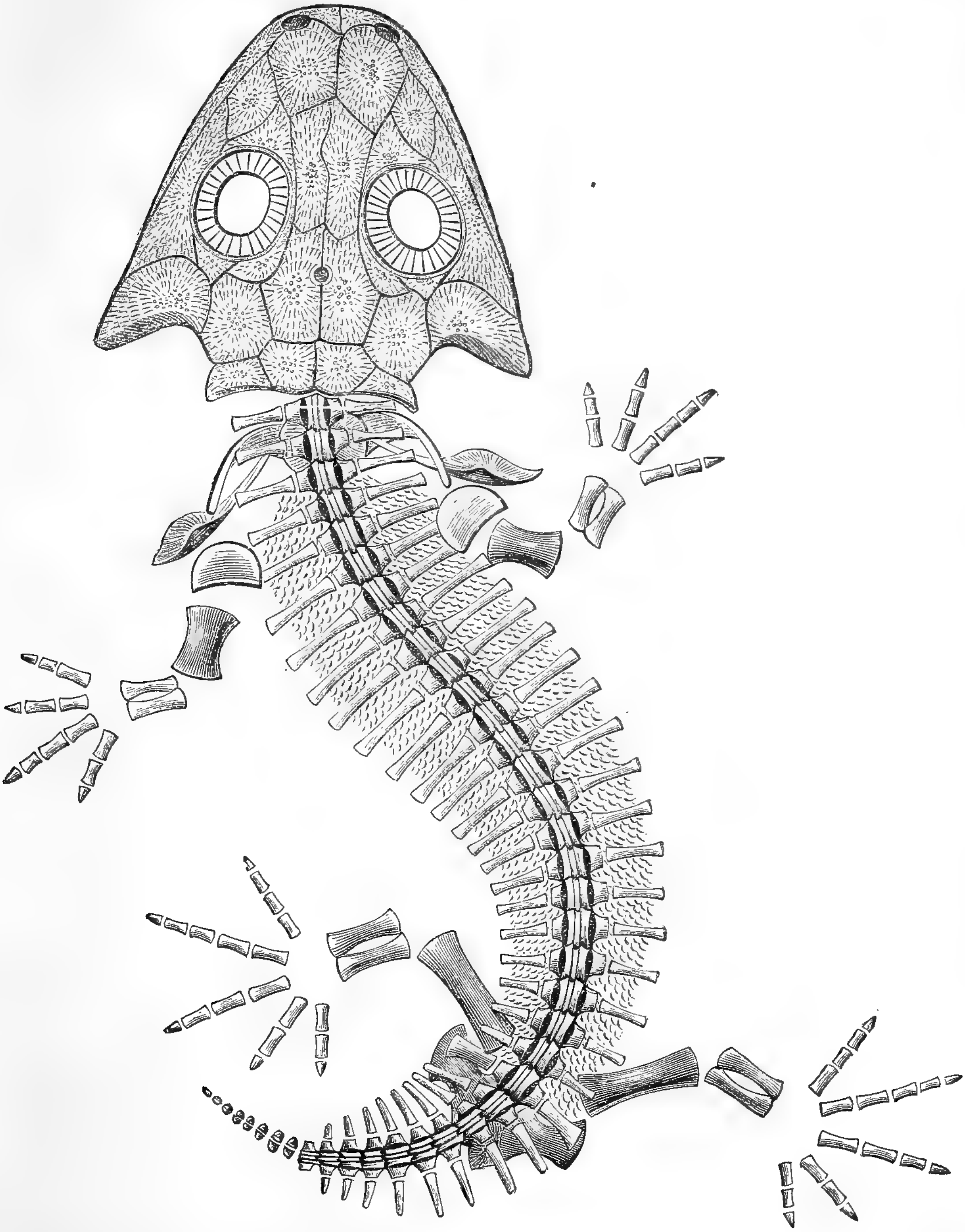


FIG. 1.—PELOSAURUS LATICEPS (FROM ABOVE).

When in the beginning of the present century Lamarck maintained that the horse had been evolved from many-toed ungulate animals by a process of gradual transformation, Cuvier replied that he would not accept this view until Lamarck could show him a three-toed horse. The forerunner of Darwin was brought to silence by this demand. But in our days Cuvier might behold the entire pedigree of the horse from the five-toed Eohippus —an animal no larger than a fox—to the three-toed Hipparion, and so on to the modern one-toed horse, all duly displayed in American museums. The Archæopteryx of Solenhofen (SCIENTIFIC NEWS, vol. ii., p. 309), with its toothed beak and its long lizard-like tail, is a true primæval bird, and fills up an important gap in the most significant manner. Recently more and more intermediate links have been brought to light, and the rocks speak a language convincing to all who will listen.

In the last few years, Professor H. Credner, of Leipsig, has published a series of memoirs on the Stegocephala. In these papers he has made us acquainted with the structure and the development of a group of animals which became extinct millions of years ago, a group whose existence falls in one of the earliest periods of the earth's history, and which comprises the earliest terrestrial, air-breathing vertebrate animals brought forth by our earth.

In the Plauen Glen, near Dresden, a deposit of limestone is being quarried, of small extent and thickness. But it contains fossil newts, varying in length from two to eight inches, and in such numbers that Credner succeeded in obtaining above a thousand specimens. The skeletons of these little creatures lay upon the grey limestone in so faultless a state of preservation that they could be submitted to the most minute examination. Ten distinct forms were discovered by Credner, and the accompanying figure (1) shows in natural size one of the most characteristic species, *Pelosaurus laticeps*. The broad, roof-formed skull, whence the name of Stegocephala, "roof-heads," given to the entire group, is the most striking feature. The body is compact, the tail short, and the limbs well-developed. In the front of the head we see the two nostrils, then the orbits of the eyes, protected by a ring of bony plates, and, finally, a hole in the middle of the skull, between the two parietal bones.

This hole was formerly a puzzle, but its meaning was interpreted last year, since De Graaf and Spencer have shown that in certain lizards there is *an eye* at the same place in the skull. This eye is certainly no longer used for sight, but it possesses the same complicated structure as other eyes among the vertebrates. This so-called parietal eye seems to have been still active in those ancient newts, for Credner succeeded in showing that the fine scales covering otherwise the entire skull were not developed over the parietal aperture, so that the parietal eye lay exposed—an observation of very high theoretical value.

The curious scaly coverings of the abdomen can be seen through the ribs, and are fully shown in figure 2, which represents an allied species (*Branchiosaurus amblystomus*) from below. The short ribs afforded no protection to the abdominal organs. Hence the Stegocephala required a strong scale-armour on their lower surface. Credner has succeeded in showing how this armour was gradually developed during the growth of the animal. It first appears over the region of the heart, then it spreads down over—or rather under—the abdomen, as in figure 1, and lastly, as in figure 2, it covers the lower side of the four extremities and of the tail. As the possession of this scale-armour is characteristic of all the earlier amphibia in contradistinction to those of more recent periods and of the present, the former are known as "scale-amphibia."

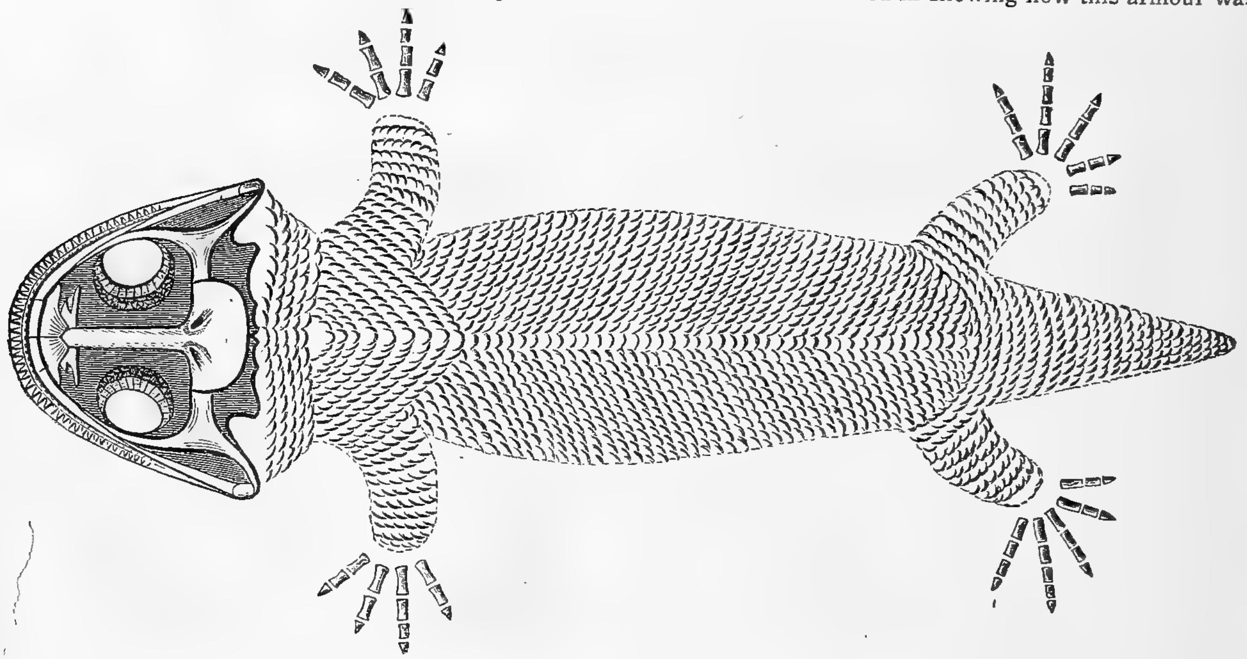


FIG. 2.—BRANCHIOSAURUS AMBLYSTOMUS (FROM BELOW).

A much more important fact was elicited on the study of the younger individuals, *i.e.*, that in youth the stegocephala breathed by gills, but when mature by lungs. Their development, therefore, was exactly similar to that of frogs in the present day. The arches of the gills are not easily recognised, but small, conical teeth were attached to them, exactly as it is observed in modern fishes and amphibia. Such elegant rows of teeth are found in almost all young stegocephala, behind the skull, and both sides of the back-bone. The fossils in question rank among the most highly prized treasures of the Leipzig Geological Museum.

MARS AND ITS "CANALS."

(*Continued from p.* 434.)

WHEN Mars appeared again in opposition this year M. Perrotin had at his disposal a much more powerful instrument than heretofore, an equatorial of 76 centimetres aperture. With this he easily saw the canals, both single and double. He further detected a very curious phenomenon. A small continent to which Schiaparelli had given the name of Libya had disappeared, and was surmised to have been overflowed by the adjacent seas. In this conjecture there was nothing irrational, since a similar occurrence had taken place in 1879. However, the hypothesis of the disappearance of Libya is very doubtful, since M. Perrotin, in a recent communication, announces that this region has reappeared, with the usual light and reddish tint of the supposed continents of Mars. Hence the inundation, if such took place, must have been of a very temporary nature. Schiaparelli also observed (figs. 1 and 2) a canal traversing the northern polar cap. In the dazzling whiteness of the snowy mass there appeared a black line connecting two seas. Nepenthes was excessively black, and presented the same aspect as it did to Holden in 1875. It seemed as if that snowy region which is separated from the polar cap by a black line was less white and brilliant than the polar cap itself.

On May 13th Schiaparelli made the following observations: "Striking novelties have presented themselves in the regions called Phlegra and Propontis; with low magnifying powers we see merely a series of confused shadows, but on employing 500 and 650 they were resolved into a kind of curious triangulation, one side of which is double. This triangulation is continued further to the left. There are at least two more triangles. Their apices form very distinct black spots, somewhat elongated in form, and the ground colour is yellowish."

After the existence of the canals, after their gemination, this triangulation forms the culminating point of the mysteries of Mars. What an analogy between this figure and the trigonometric draughts of our geodetic operations!

Professor Schiaparelli further adds that the lake Triton had changed into a broad gulf of the Cimmerian Sea.

The Milan 18-inch refractor further enabled the observer to distinguish from each other the two margins of certain canals, and to perceive their undulations.

On June 7th Schiaparelli writes, "I have seen the planet fairly well on May 9th, 25th, and 27th, and much better on June 2nd and 4th. I saw the prodigious images which presented themselves in the field, like an exquisite steel engraving, but illuminated with the magic of colours. A power of 650 did not suffice for the complete detection of details, and I regretted having had the disc reduced to 12 inches in diameter. Not only have I confirmed the gemination of Nepenthes and the reappearance of the lake Triton of 1877, but I have also seen the Lacus Mœris reduced to a very small point. Hephæstus has entirely disappeared. Œnotira is no longer visible. Euphrates is double throughout its extent, but it is not as plain as on May 27th and 30th. The two lines are slightly washed out. Callirrhoë and Protonilus are two geminations, very narrow, but geometrically perfect and very black, especially Callirrhoë. These features require a magnifying power of 650 to be distinctly seen. The two lines of Callirrhoë are equal, but in Protonilus the upper line, though much more slender than the lower, is perfectly traced. The Phison is double, almost like the Euphrates. Astaboras is also double, but it is more visible to the left of Phison. Syphonius and Orontes are single, as is also a new line marked X in the drawing (see fig. 3).

"But, perhaps, the most perplexing feature is the frequent and rapid change recognised in Mars. Oxus has grown much fainter, and latterly I can no longer see it, whilst Indus has reappeared. Hiddekel is almost invisible. Gihon is slightly clouded; it goes towards a small lake from which there issue two lines towards the lake Niliacus. The changes which have occurred within a month in Boreosyrtis and the surrounding regions! What a strange complexity! What may all this signify? Evidently the planet has fixed geographical details, similar to those of the earth, with gulfs, straits, etc., irregular in plan. Then comes a certain moment, and all this disappears, giving place to those grotesque polygonations and geminations which evidently seem to form an approximate representation of the previous condition of the planet, but as if masked and almost caricatured.

"How is it, we may here ask, that no decisive observations on the existence of mountains in Mars have been made, or at least published?"

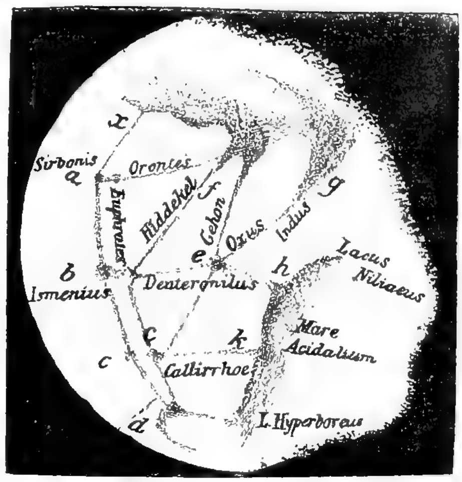


FIG. 3.—SKETCH OF MARS AS IT APPEARED ON MAY 27TH, 1888 (AFTER SCHIAPARELLI).

Before proceeding to the hypotheses which have been propounded in explanation of these strange facts, we may mention the circumstance, noted by M. Schiaparelli, that the phenomenon of gemination is connected with the seasons of the year of Mars, and occurs especially between the spring equinox of the northern hemisphere and its summer solstice. It would be impossible to say if the same state of things occurs at the autumnal equinox.

(*To be continued.*)

THE SERPENT IN THE MYTHOLOGY AND THE WORSHIP OF ANCIENT NATIONS.

DR. MORITZ WINTERNITZ, who is preparing an exhaustive work on serpent-worship in India, has published a preliminary sketch of his views in the

Mittheilungen der Anthropol. Gesellschaft zu Wien and in the *Naturforscher*. He considers that there is scarcely any animal which has played so great and so manifold a part in the religious conceptions of all nations. The mythogenetic or saga-framing imagination has formed the most varied beings out of serpents. At first it is always the serpent as an animal to which fable and worship attach themselves. It is a fact that snake-myths and snake-worship are found wherever snakes exist—that is over the whole earth (?)—but more especially in those lands which are richest in serpents, India and South America. Although the bodily properties of the serpent do not, to the keenly discriminating eye of the naturalist, entitle serpents to take such a position, the lay public, and especially the savage, see differently, and it is their superficial consideration of physical properties which determines the popular conception of serpents. Thus, the uncanny, flashing eye of the serpent, which does not strike the zoologist as remarkable, plays a very prominent part. Hence among the ancient Greeks the serpent was regarded as the most sharp-sighted of all animals. Hence there arose numberless sagas concerning the magical action of the serpent's look—fables which still live in narratives of the fascination exerted by serpents upon birds, and which have made their way even into scientific treatises. We may here, however, interpose a question whether birds and and other small animals by gazing fixedly at the eyes of a serpent may not fall into a trance or hypnotic condition, during which they become a ready prey. This influence, apparently exerted upon their enemies, together with the docility which many serpents evince up to a certain degree, led to the ascription of an exalted intelligence to serpents, and naturally brought them into close connection with magic and soothsaying. Throughout the East the serpent is an object of sorcery. The Delphian oracle—the most famous of all in Greece—was guarded by the dragon python. Many Oriental sagas represent priests and prophets as being indebted to serpents for an understanding of the language of birds. In like manner German fables describe the king as learning the language of animals by eating a white serpent, which reappears in Hindu literature as the all-knowing, deeply learned itself and imparting knowledge. The universality of this article of popular faith appears from the fact that even in South America the serpent appears as oracular.

In consequence of the profound knowledge attributed to serpents, we need not wonder that they were connected with the metallic treasures of the earth. Winternitz suggests that the rich metallic lustre which many snakes display may have contributed to this representation. But we may also consider that the abode of snakes in cavities and chinks of rocks may have led them to be regarded as mine-spirits and guardians of treasures. In the old German mythology the dragons sleep upon gold, and in Greek sagas the "Golden Fleece" and the apples of the Hesperides are committed to the keeping of the serpent. Throughout Asia and America is spread the belief in strange, black, shining stones which serpents bear in their heads. That the mine genii are represented as winged snakes may be due to the speed with which these creatures seem to glide down precipitous rocks.

The moulting of serpents gave rise to fables of another kind. Since the serpent seemed thus to renew its youth, it was regarded as immortal, and was adopted in the mysteries. Here we find the first step taken to the sagas, which describe serpents assuming various forms, and especially as transforming themselves into beautiful youths and maidens.

Above all, the fearful action of its venom has brought the serpent to high popular honours. Says an Indian proverb, "No one is reverenced, however great he may be, until he has wrought evil." Thus the serpent has been deified, worshipped as an evil demon, on account of the terrific death-dealing power of many species. As such it appears in the Hebrew history of the Creation, and in the Zendavesta Ahriman, the evil principle, figures as the great serpent. But on the other hand was the belief that the same being which inflicted sickness and death could heal and quicken. This representation of a conflicting dualism in one and the same being is found distinctly embodied in all antiquity. As examples are the head of the Gorgon, combining beauty and horror, or the lance of Peleus, which alone could heal the wounds it had inflicted. Thus the serpent alone was supposed able to counteract its own deadly bite. Not merely snake-bites, but other diseases, were supposed to be cured by serpents. So closely were they connected with the art of healing that the god of medicine, Asklepios (vulgarly Æsculapius), himself figures as a serpent, and a rod entwined with snakes is still the symbol of his followers. All manner of remedies were prepared from serpents by the physicians of antiquity and of the middle ages, and even in the last centuries the consumption of poisonous serpents by pharmacists was so great that multitudes were imported from Egypt.

But when once serpents had come to be regarded as beneficent beings, healers of disease, only a small step was needed to convert them into good spirits, tutelary genii, the bringers of good fortune. As serpents often were found inhabiting tombs, they were connected with the spirits of the lower world, and regarded as the souls of the departed, the manes, the heroes. Thus snake-worship links itself with the worship of forefathers, as we find alike among the Zulus, the Red Indians, and the Greeks. But the same worship is also closely intertwined with the veneration of the house-gods, the penates. Thus numerous nations viewed serpents as beneficent tutelary spirits, whose destruction would involve the ruin of the family or the tribe. Such was the case among the Teutons, Sclaves, Greeks, Romans, peoples of the East, of Africa and America. In Mexico, Yucatan, and Guatemala even human sacrifices were offered to serpents. The deity Cihuatcohuat, the "woman-serpent," was regarded as the mother of mankind, and the saga of creation among the Quiches of Guatemala tells us that "in the beginning was only God the Creator, the mighty Serpent."

Thus we see the serpent pass through all changes from a rude fetish to mythological beings, evil demons, and good spirits, and ultimately appear as the Supreme Deity.

The deification of the serpent was promoted by the circumstance that various natural phenomena seemed to contain its image. Earthly and heavenly waters, the "serpentine" river, the black storm-cloud, and the descending lightning were all viewed as serpents.

Perhaps the last stage of evolution through which the serpent has passed is when the abstract idea of eternity is shadowed forth as a coiled-up snake. Thus the Orpheic deity, Æon, and Chronos himself are represented as wound round by a serpent.

General Notes.

The Alleged Mongolian Affinities of the American Race.—Dr. D. G. Bienton (*Science*) ably, and as we we think convincingly, combats the theory that the aborigines of the Western Continent are of Mongolian origin.

Boring for Water in Queensland.—We learn that the Government has accepted the tenders of Messrs. Jessop and Haig for boring for water to a depth of 10,000 ft. in the Central district, and 7,500 ft. in the Southern district.

The Decomposability of the Benzol Nucleus in the Animal System.—Dr. N. Juvalta has solved this interesting physiological question in the affirmative. From very careful experiments, he found that the benzol-nucleus, as contained in phthalic acid, is destroyed in the digestive organs of dogs.

Sanitary Neglect.—Dr. Parkinson (*Royal Society of Tasmania*) complains that at Hobart the foul water from a stagnant pool is allowed to pollute the general town supply; that filth is left lying exposed to an almost tropical sun and house slops trickling all day along slimy channels in front of the very doors.

The Origin of Cannibalism.—This custom, widely diffused in ancient times, and still existent, notwithstanding the assertion of Waterton, is ascribed by a writer in *Cosmos* to the "necessity of sacrifice." But as the same custom may be traced in many animals, mammalia, birds, fishes, insects, and spiders, this view cannot be accepted.

East African Exploration.—Count Teleki, with Lieutenant Hohnel, have arrived at Zanzibar, Oct. 28th, and report the discovery of a lake named Basson-Aros due north of L. Baringo. This lake, which is filled by two rivers flowing into its north end from the west and north, extends from 2 degs. to 5 degs. north west of L. Samburu.

Alleged Cure for Yellow Fever.—According to the *Electrical Engineer*, the actinic rays of a powerful arc lamp constitute an effectual remedy for the yellow fever. *Cosmos* admits that solar light is deadly to some bacilli, but questions if such can be the case with the germs of yellow fever, which evidently live and increase in brilliant sunshine.

New Minor Planet. — Dr. Palisa, of Vienna, announces the discovery of the 279th minor planet at 7 p.m. on the 25th ult. The position at the above time was—Right Ascension, 0 h. 53 mins. 36 secs.; North Polar Distance, 87 degs. 5 mins. 2 secs.; moving southwards. The planet is about equal in brightness to a 13th magnitude star.

Yellow Fever.—Surgeon-Major Riordan (*Medical Press*) remarks that yellow fever, though it has repeatedly visited Europe and Africa, has never penetrated into Asia or Australia. It differs from cholera in being confined to warm countries, and in the fact that a person who has survived one attack generally enjoys immunity for the rest of his life.

The Exploration of Greenland.—If Dr. Nansen and his daring companions have effected their purpose they will have left the Bay of Disco on September 16th, in a sailing-vessel, which was to wait for them to that date, and which may be expected in Copenhagen shortly. If they have not reached Disco by that time we shall not learn their fate before next summer.

International Geographical Congress.—The Paris Geographical Society proposes that such a congress should meet in Paris in 1889. Seven sections are proposed: 1. Geodesy, hydrography, topography; 2. Physical geography; 3. Economical and commercial geography; 4. Historical and ethnographic geography; 5. Educational geography; 6. Travels and explorations; 7. Cartography.

Salicylic Acid in Eggs.—According to *Cosmos*, salicylic acid, the use of which in articles of food as an antiseptic is interdicted by law in France, is introduced into eggs. It is dissolved in water, in which the eggs are immersed, and it penetrates by endosmose through the shell and the internal lining of the egg, and diffuses itself into the yolk. It is obvious that a variety of poisons may be introduced into eggs in this manner.

The Earthquakes in New Zealand.—Mr. Gordon, mining inspector, who was despatched by the Government to the Harmer Springs district to report upon the effects of the recent earthquakes, states that he found fissures ranging from one to four inches in swampy ground at the extremity of a line extending 20 miles north-west from the Springs. He found rents in hard ground some 2 ft. wide. He attributes the recent phenomena to chemical rather than volcanic action, owing to the vast quantity of sulphuretted gas liberated in the disturbed locality.

Adulteration of Sherry.—According to Dr. Thudichum, much of the wine shipped as sherry contains sulphuric acid in the proportion of 1 lb. per butt, besides 4 lbs. of sulphates, whilst the alcohol present, which naturally cannot exceed 12 to 14 per cent, is raised fraudulently to 26 per cent. by the addition of "evil spirits." "It is curious," says a medical paper, "that the amount of spirit which would be required to raise the 75,000 butts exported from Xeres in 1886 from 14° to 26° corresponds fairly with the amount of potatoe-spirit imported annually into Cadiz from Germany."

The "Giant Caloric."—Professor S. P. Langley, in his address before the American Association for the Advancement of Science—where, by the way, the opening discourse is delivered, not by the incoming, but by the retiring President—says happily that "the conception of phlogiston before it quitted the world perpetuated in physics the wrong in a multiplied form by generating an offspring specially inimical to true ideas about radiant heat, and which is represented by a yet familiar term. I mean caloric. 'Giant Caloric' is not, perhaps, even yet quite dead, though certainly grown so crazy and stiff in the joints that he can harm the pilgrims of science no more."

Glaciation in the Azores.—Hartung has discovered blocks of gneiss in the midst of a volcanic district, even at some distance from the coast, and has drawn the conclusion that they were erratic blocks, brought by icebergs. In *Humboldt* we find mention of a different view quoted from Simroth in the *Globus*. The inhabitants of Terceira state that these stones have been brought by ships as ballast, and have been used by the country-people for building their houses and garden-walls. This view is supported by the fact that the two spots where these stones have been found are not on the north side of the island, where ice-bergs would be stranded, but on the south and east coasts. The Azores have probably never been glaciated. Simroth was unable to find marks of glaciation even on the Pico, 7,000 feet above the sea-level, where snow falls every winter.

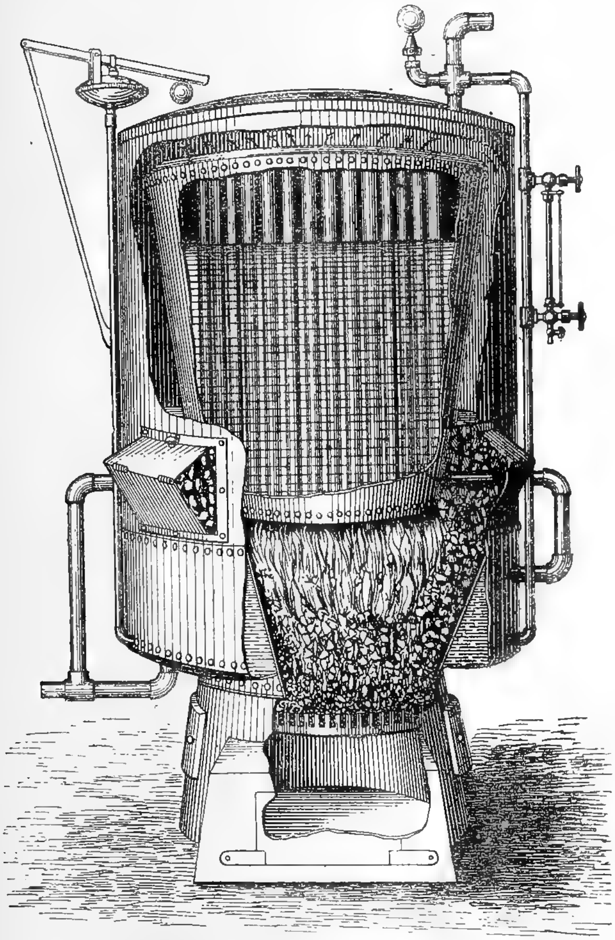
ACTION OF ELECTRIC CURRENTS UPON DELICATE BALANCES.—The *Naturwissenschaftliche Wochenschrift* remarks that as delicate balances are often strongly affected by very slight causes, such as trifling fluctuations of temperature or slight agitations, the question is justified in how far such instruments, as containing iron or steel, are disturbed in their sensitiveness by electric currents. The *Central-Zeitung für Optik und Mechanik* writes that certain manufacturers have refused to introduce the electric light in their establishments lest the current should injure their balances. Hence, G. H. Terry, of New York, has made a formal investigation of the alleged influence. To this end he placed balances of precision near very powerful currents and sought to discover any irregularities. But nothing could be detected. The balances contained very little iron or steel. For greater certainty he therefore placed a piece of iron in one scale and brought very near it a conductor traversed by a powerful current. No action was perceived until the current was brought within 3 millimetres of the iron. From these researches it follows that the currents used in electric lighting can have no effect upon balances of precision.

THE PINE FORESTS OF WESTERN FRANCE.—In a report on the agriculture of the Gironde, the British Consul at Bordeaux refers to the forests which cover about a third of the department, especially the Landes district, where the soil is wholly unfitted for ordinary cultivation. Hence forests of pines (*pin maritime*) have in recent times been planted, and the wood and resin obtained from them have now become an important and, in some instances, the sole source of revenue of the inhabitants of those districts. In the parts distant from towns and other inhabited places, resin is chiefly produced, while in places nearer to Bordeaux or other shipping ports, where means of transportation exist, the production of pit props, railway sleepers, telegraph poles, and wood for fuel forms the chief business. The collection of resin affords a living to a large number of the very poorest persons, and the recent decline in the exportation of this article from Bordeaux has been a great misfortune to the inhabitants of some parts of the Landes district. The decline has been caused by the annually increasing competition of the United States, which has become the chief exporter of resin, to the almost entire exclusion of Bordeaux. A new kind of oil, called pine oil, is now made from the refuse of resin after the latter has been employed in making turpentine. This is used as an illuminant in some private houses in Bordeaux, and burns very brightly; it is cheaper than refined petroleum, and is not explosive. The trees do not appear to suffer by the extraction of the resin, if it be done carefully, and the wood is even better fitted then for certain purposes, such as paper-making and the manufacture of pyroligneous acid, than it was before. The export of pit props made from the Landes pines is an important branch of trade between Bordeaux and English ports adjacent to coal districts. Railway sleepers and telegraph poles are likewise made in large quantities in these pine forests; they are used chiefly in France. Besides, a large quantity of young pine finds its way to England every year to be converted into paper. The Landes is a sandy district in which nothing but pines will grow, and the forests are all of recent origin.

THE PUBLIC HEALTH.—The Registrar-General's return for the week ending Saturday, October 20th, states that the deaths registered in 28 great towns of England and Wales corresponded to an annual rate of 21·0 per 1,000 of their aggregate population, which is estimated at 9,398,273 persons in the middle of this year. The six healthiest towns were Bradford, Brighton, Halifax, Huddersfield, Hull, and Leicester. The highest annual death-rates, measured by last week's mortality, were—from measles, 1·3 in Blackburn and in Wolverhampton, and 1·9 in Leeds; from scarlet fever, 1·6 in Sunderland and in Derby, and 2·6 in Blackburn; from whooping-cough, 1·0 in Cardiff; from "fever," 1·0 in Preston, 1·2 in Salford, 1·4 in Bolton, and 1·6 in Birkenhead; and from diarrhœa, 1·5 in Portsmouth, 2·5 in Preston, and 2·8 in Bolton. The 53 deaths from diphtheria in the 28 towns included 36 in London, and 6 in Manchester. Small-pox did not cause a single death in any of the 28 great towns. In London 2,459 births and 1,641 deaths were registered. Allowing for increase of population, the births were 329 below, while the deaths exceeded by 30 the average numbers in the corresponding weeks of the last ten years. The annual death-rate per 1,000 from all causes, which had increased in the four preceding weeks from 15·8 to 18·7, further rose last week to 20·0, and exceeded the rate recorded in any week since April last. During the first three weeks of the current quarter the death-rate averaged 18·4, and was 0·3 below the mean rate in the corresponding periods of the ten years 1878-87. The 1,641 deaths included 80 from measles, 33 from scarlet fever, 36 from fever, diphtheria, 12 from whooping-cough, 19 from enteric 1 from an ill-defined form of continued fever, 42 from diarrhœa and dysentery, and not one from small-pox, typhus, or cholera; thus 223 deaths were referred to these diseases, being 19 above the corrected average weekly numbe Different forms of violence caused 51 deaths; 45 wer the result of negligence or accident, among which were 18 from fractures and contusions, 6 from burns and scalds, 4 from drowning, 3 from poison, and 10 of infants under one year of age from suffocation. In Greater London 3,233 births and 2,004 deaths were registered, corresponding to annual rates of 30·5 and 18·9 per 1,000 of the estimated population. In the outer ring 10 deaths from diarrhœa, 8 from diphtheria, 5 from measles, and 5 from whooping-cough were registered. The 8 deaths from diphtheria included 2 in Godstone, 2 in West Ham, and 2 in Walthamstow sub-districts. Both measles and scarlet fever also caused 2 deaths in West Ham sub-district.

THE GORTON BOILER.

IN the construction ot the Gorton heaters, one of which we show in our illustration, the plan of the upright tubular boiler has been wisely retained, and the additional advantages of self-feeding as well as surface burning have been incorporated by an ingenious device, enabling it to work well either way. The coal reservoir is between the lower outside surface of the boiler and the water leg, thus economising a space of from 9 to 12 ins. in diameter in the centre of the boiler for active heating purposes, while the tubes are directly above the fire, the heat passing up through them to the top, and thence down on the outside between the boiler and jacket to the smoke



pipe at the back. The reservoir will hold enough fuel to keep up a steady fire for from twelve to twenty-four hours. The boiler is designed to generate steam in an economical and effective manner, the tubes being placed as thickly as will admit of proper circulation, and its evaporative efficiency is calculated as fully equal to that of the return tubular boiler. The coal pockets in the Gorton are placed sufficiently low down to enable any one, even a child, to put on fuel, and thus there is no reaching up over one's head with a scuttle of coal, as is so very often the case with other styles of boilers, especially centre-feed boilers.

The grate, which is "cupped," or lower in the centre than at the periphery, has its outer or main part resting on ball bearings, so that it can be easily shaken, this allows the coal to feed down as it is needed and distribute itself uniformly; the centre part is independent and arranged to open on one side for removing clinkers. A recent improvement in this grate, and one possessed by no other steam-heating boiler, consists of additional air spaces, which provide for the free circulation of air at all times to the combustion chamber. It is known that the amount of steam produced is in proportion to the regularity and intensity of heat employed to generate it; that hence it is easy to understand, that if the temperature of the fire be lowered through clogging of the grate with ashes, the temperature of the premises is proportionately affected. With the improved grate as now furnished to this boiler, clogging is impossible, as in whatever manner the ashes may fall upon the grate, they cannot interrupt the draught. This ensures perfect combustion and a uniform temperature. These boilers are made of wrought iron, and are simple, of superior construction, and are particularly adapted for warming private dwellings, public buildings, hotels, apartment houses, and office buildings. They can also be used for manufacturing purposes as well as for heating buildings, and are fully guaranteed for a working pressure of one hundred pounds.

STORAGE OF MATERIAL AND FORCE IN PLANTS.

IF we take a pea-seed and place it in moist ground in the spring-time, it will soon begin to grow. First the root protrudes and passes downwards, then a little stem appears and ascends into the air towards the light, and a small group of leaves opens at its extremity. The stem continues to grow, more leaves are put out, they become of a deep-green colour, and if the plant be placed where light, air, and moisture act upon it we soon have a plant some feet in height, with a long stem, many leaves, and at length flowers appear. When the autumn comes the fruits are full of ripe seeds, and at length the leaves wither and dry up, losing their green colour, and the plant dies. Now if we carefully remove the plant entire, with its root, and leaves, and fruit, dry it and weigh it, we shall find that it weighs many hundred times as much as the seed from which it grew. Where has the material which makes up the difference in these weights come from? If the dried plant and all its parts be now completely burnt the weight of the ash or inorganic matter is ascertained. This was derived from the ground. The rest of the weight of the dried plant was manufactured by the leaves of the living plant, from the carbonic acid gas taken in from the atmosphere to the cellular tissue of the leaf, and there, through the agency of the cells of the leaf, under the stimulus of light, the carbonic acid gas absorbed was decomposed, the oxygen being returned to the atmosphere and the carbon united with the elements of water to form a new organic material called starch, which accumulates in the cells which were the agents for its production. This process of manufacturing starch in vegetable cells under the stimulus of light is termed *assimilation.* There is a substance in the cells which perform this work called *chlorophyll*, which is formed previous to the manufacture of starch, and the quantity of starch made by healthy leaves is, within certain limits, proportional to the quantity of light that illuminated the leaves. Now, as to the storage ot this new organic material, starch, when it has been made, this takes place in various parts of the plant. The cell where starch has been produced may itself serve as a reservoir, but usually the newly formed material is transferred to other growing parts, such as the buds and the root. In the case of the pea-plant much material is consumed, first in growth, and later in making the substance of the pea-seeds in the fruit. In many cases the newly formed material is transferred to some thickened part of the plant underground, some part of the stem or root, where it is kept safe till the plant begins to form its seeds. When reserves of material are thus formed underground they are less liable to be attacked by animals. The young pea-plant is destroyed if a pigeon eats off the top of the plant; a potato plant may have its leaves cropped by a cow and yet survive, because it has a reserve of starch in its tubers or thickened underground stems.

Now, as to the storage of force in plants, this is always the result of growth, and examples are mostly seen in the flowers and fruits. The flowers and fruits of plants may be said to be the results of their highest stages of development; a long series of actions takes place in the plant before it produces flowers and fruit. Many acts of growth and much formation of new material occur in the plant before the highly complex flowers appear, and it must be remembered that the formation of new material results from the action of light upon structures in the leaves. If the plant be healthy and has accumulated reserves of starch, flowers and fruit can form in parts excluded from light—light is not necessary to the formation of flowers. Flowers may grow from flower-buds without the stimulus of light; it seems as though some intrinsic forces were accumulated in the plant (probably the results of its inheritance) which will suffice for the growth of the flower from the bud if the plant has accumulated sufficient material.

A good example of storage of force is seen in the Kalmia-blossoms (*Kalmia latifolia*). The corolla closes in both the style and the stamens, which are seen just inside the corolla; the upper enlarged part of the stamen is its anther, or pollen-box, and this is lodged in a small pocket of the corolla. The stalk of the stamen, or filament, becomes bent as the corolla opens. The expansion of the corolla curves the filament outwards; this creates a mechanical tension in the filament. It is said that the "corolla opens;" this is a result of a certain mode of growth in the corolla which it is important to understand. While the corolla is in the bud state the inner surface of the corolla grows less quickly than the outside, and as a result the inner surface of the corolla remains concave, and the corolla closed. When growth is almost completed the inner surface of the corolla grows more quickly, with the result that what was the inner and concave surface now becomes convex and the flower opens, the style is exposed to the air, its stigma becomes the most prominent part of the flower, and the filaments of the stamens are placed under tension, their upper surfaces becoming convex; the anthers are still held mechanically in the pockets of the corolla. It may be seen that the cause of the tension in the filaments results from the movement of the parts of the corolla, and that this results from an alteration in the ratio of growth of the surfaces of the corolla. The tension in the filaments results from the ratios of growth in the surfaces of the corolla, and this is due to the inherited intrinsic forces in the plant. The anther, or pollen-box, discharges pollen through a small orifice at the apex of each cell.

When an insect settles upon the flower it touches first the stigma, which is the highest part of the flower; the shaking which the flower thus receives liberates some of the stamens, and the anthers being liberated fly upwards and discharge their pollen on to the insect, which flies away with some of the pollen of this flower adhering to it. Now consider two such flowers and the bee which passes from one to the other collecting honey. The first open flower that he visits dusts his body with pollen; this he carries to the next flower visited, and there deposits some upon the stigma, at the same time receiving a fresh supply of pollen, which he carries off to the next flower. Thus cross-fertilization of the flower is effected. Whenever we come to observe movements of parts in plants the case is much more complex than with conditions of growth, the results much more striking and wonderful, and such examples are found in the most highly developed parts of the plant. Such examples are not spoken of as due to intelligence in the plant, but are very analogous in their outcome to acts that are termed signs of intelligence in animals. Storage of force is seen in the growth of many fruits, and usually leads to the scattering of the seeds by mechanical means. In a species of wild geranium (*Geranium dissectum*), when the other parts of the flower have fallen, the central axis elongates in its growth; each seed is contained in a case, which is supported by a rod of tissue, which in the early condition of the flower forms part of the central axis, but gradually becomes detached from it. When the seeds are ripe the case containing the seed becomes detached from the base of the supporting column and splits open, the rod is in a state of tension, and eventually becoming detached with a jerk, the seed is thrown some little distance. The cause of the tension in the rod is the unequal growth which occurs in its inner and outer surfaces; the inner surface, or that next to the central support, grows the most; tension or storage of force is thus produced, the mechanical energy is suddenly displayed when any jar is communicated to the plant, and scattering of the seed results. Examples of the storage of mechanical force might be multiplied. The lessons we may learn are that conditions of growth may produce mechanical action, which for a time may be stored up in latent form, and then become suddenly manifested in movement, producing a visible effect, which in its turn leads to important results to the species. Cross-fertilization is very important in producing good seeds. Scattering of the seed is essential to the spread of the species over the surface of the earth.

A Petrified Forest.—M. Philippe Thomas announces to the Paris Academy of Sciences, that he has discovered in Tunisia a gigantic forest, all the trees of which are silicified, and which is thus an exact copy of the celebrated forest of agate at Cairo. M. Flische has recognised the same species as in Egypt, such as *Araucarioxylon egyptiacum*, *Bambusites Thomasi*, and *Cossoni*, a *Ficoxylon*, an *Acacioxylon*, etc. But whilst the palæontologists, Hooker, Fraas, Zittel, and others, disputed on the age of the forest at Cairo, which seemed cretaceous to some and quaternary to others, the age of the Tunisian forest is manifest, and is referred to the pliocene or upper tertiary. M. Bleicher attaches the fact of the silicification of trees to the presence of free gelatinous silica in the enclosing rocks.

Natural History.

COCHINEAL INSECTS.

It is somewhat of a surprise to most of us to learn that Cochineal Insects—which form a tolerably extensive family—are found in many parts of the world, and that their value was at least partially known to the ancients; for one is rather apt to look upon them as quite a modern discovery, and also to consider them as strictly confined to certain specified districts of South America. But although it is true enough that the cochineal of commerce does come principally from these districts, and that *Coccus cacti*, the particular species from which it is procured, is somewhat limited in its distribution, there are many insects belonging to the same genus which yield a dye almost equally valuable, and which, if cultivated in like manner, would probably bring in a very good return for the labour and money expended upon them.

And some of these have been more or less extensively employed for many centuries. Thus the red pigment which can be obtained from *Coccus ilicis*, to be found upon a small species of evergreen oak, and which is plentiful alike in Southern Europe and in Northern Africa and Asia, was largely used by the Phœnicians in dyeing cloth even before the time of Moses, and was known by the title of Thola, or Tola. The Greeks knew it by the name of Kokkos (*Coccus*), and the Persians and Arabians by that of Kermes; from which latter term, by a rather curious series of transitions, our own word "vermilion" is supposed to have sprung. With the dye obtained from this insect were stained the Flemish tapestries, the characteristic red colour being scarcely affected by the action of time; and the Greeks and Romans also appear to have employed it very largely both in their arts and in their manufactures. It has also been suggested, and with great show of probability, that to this same dye was due the "scarlet"—or, as it should be, the crimson—of the curtains of the Mosaic Tabernacle (Exodus xxvi. 1, and xxxvi. 8). And even at the present day it is held in great esteem both in India and in Persia.

Branch of Cactus with Cochineal Insects.

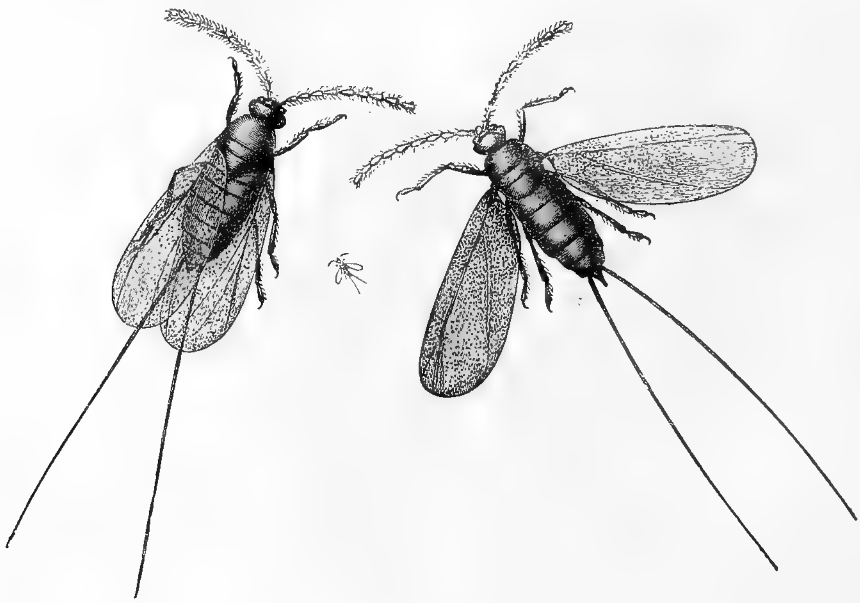
In Poland the place of this insect is taken by *Coccus polonicus*, which is found upon the roots of *Scleranthus perennis*, and which was at one time very greatly in request in the factories of Lithuania. And the Polish peasants use it even now, as do also the Turks and the Armenians, the latter employing it both in dyeing wool and silk, and also in staining the finger nails as an aid to personal beauty. *Coccus uva-ursi*, too, when treated with alum, has been employed for similar purposes, while the Moors, in olden days, availed themselves of yet another species, which lives upon the roots of *Poterium sanguisorba*.

Since the discovery of *C. cacti*, however, the value of all these has greatly diminished, the dye which they yield being very much inferior in brilliancy to that of the South American species. And the cultivation of this, the true cochineal insect, has risen to the rank of a very important industry. It is carried on principally in Mexico, the native country of the insect; but of late years exportations have been made to Algeria and the Canary Islands, and in both colonies the cochineal gardens, which for some little time met with bitter opposition and almost total neglect, are now in a very flourishing condition, and amply repay the expenditure laid out upon them.

Just as is the case with those remarkable creatures the scale insects (Scientific News, vol. i., p. 397), the sexes of the cochineal are very different in appearance, and would scarcely be recognised as belonging to the same class of beings. For the male is a handsome little four-winged fly, with a pair of feathery antennæ and two long hairy filaments springing from the tail, while his mate is an apterous, gall-like creature without the power of locomotion, and with hardly any indication of her insect nature at all. But she it is from whom the dye proceeds. The food plants are two, both being species of prickly pear (*Cactus cochinilifer* and *C. opuntia*); and these are planted out in regular lines, carefully trimmed and tended, so as to allow of free passage between them, and surrounded with a high fence of reeds and stakes to shelter them from the wind. Some of these plantations contain as many as fifty or sixty thousand plants, but the majority do not much exceed an acre in extent, and are for the most part in the hands of native Indians, who are generally distinguished by the title of *Nopalleros*.

For the first two years of their growth the plants are not brought into use; but by the beginning of the third season the more healthy ones have gained sufficient strength to enable them to withstand the incessant drain upon their juices. A quantity of newly-hatched *Cocci* are then procured, generally in April or May, and are kept for three weeks or so entirely indoors, in order that the inclemencies of the weather may not injure them while they are yet young and small. At the end of that time they are transferred to the shelter of somewhat primitive sheds, consisting merely of a rough-roof raised upon poles, so that, while the little insects are protected from rain, the air finds free admission upon all sides. And there they remain, still feeding on the succulent branches upon which they were purchased, until about the end of August, when the fecundated females are placed upon the leaves of the growing *Cacti*, there to complete their development. For some four months they are allowed to feed on without interruption, and then the first gathering is made, which yields under favourable circumstances a return of about twelve hundred per cent. upon the insects purchased. This gathering is followed four months later by a second, and four months later still by a third; and these two latter harvests are generally of a still more profitable character.

The task of taking the insects from the plants is deputed to Indian women, who squat upon the ground in their curious and seemingly uncomfortable manner, and brush them into trays by means of the tail of a stag or a squirrel, or a bamboo twig formed into somewhat the shape of a pen. As soon as a sufficient number have been collected they are killed, either by plunging them into boiling water or by placing them in heated ovens, or merely by exposing them to the rays of the sun. And then, as soon as their bodies have thoroughly dried, they are ready for the manufactory.



Male Cochineal Insects.

The importance of the cochineal gardens may be judged from the fact that, even so long ago as the time of Humboldt, the quantity annually exported from South America exceeded half a million sterling in value; and Dr. Bancroft estimated the yearly consumption in Great Britain alone at 150,000 lbs., worth some £375,000. And this quantity has since been very much increased. It is also worthy of mention that the rent of a fairly productive *Coccus* garden varies from £50 to £60 per acre, while it cannot be purchased outright for much less than £1,000. The dye itself, by the way, when compressed into small cakes, is sometimes used in lieu of money, and travels from hand to hand many times over before it at last reaches the factory.

From a congener of the cochineal insect is obtained lac, which is so largely employed in the manufacture of sealing-wax and of various varnishes; and from it is also procured a crimson dye which possesses some little commercial value. In the years 1807-1809, indeed, the sale of this dye at the India House, in point of actual colouring matter, was estimated as equivalent to half a million pounds of cochineal. The dye, as in the true cochineal, appears to afford nourishment to the young grubs until they leave the protecting shell into which the dead body of their mother collapses.

The economic entomologist can scarcely fail to be struck with the fact that these valuable insects are closely related to some of the most mischievous. Thus, on one side of their family, as it were, they are connected with the scale insects, or mealy bugs, which are so destructive to many of our fruit-trees and cultivated plants, while on the other they are allied to the *aphis*, that greatest of all the insect pests which vex the farmer's heart. Even if it be true that a man may be known by his friends, certainly an insect is not to be known by its relations. And it is quite possible that we may ultimately find of value many insects which are either noxious themselves, or which are at least closely related to others of the most highly mischievous character. A green dye, for instance, has been extracted from the caterpillars of the cabbage butterfly. And as our knowledge of natural history increases we shall doubtless be obliged to alter our present views with regard to many insects, and to detect in the future a friend where now we see but a foe.

A Hybernating Dragon-fly.—It may interest entomological readers to know that a certain European species of dragon-fly is in the habit of hybernating in the *imago* state, which singular discovery has only very recently been made by a well-known German specialist. It is not at all unimprobable that other species may be discovered to hybernate also, since so very little has hitherto been done towards the elucidation of their economy. Most dragon-flies pass the winter in the *larva* state, and seldom allow themselves to become torpid, even in the most severe weather.

The Batrachia of Southern India.—In a work recently published by Mr. Edgar Thurston, of the Government Museum at Madras, fifty-five species of frogs, toads, and cœcilians are enumerated. The newts, or tailed batrachians, are not represented in Southern India. In Ceylon only thirty-three species of batrachians occur, eighteen of which are found also on the mainland. The *Madras Weekly Mail*, noticing the above work, adverts to the gymnastic feats of the "chunam frog." A genial writer, seated one evening in his garden, was finishing an interesting chapter, when an adventurous "chunam frog" lighted like a dab of mud behind his right ear, and there stuck! The batrachians of Southern India, however, are as yet very imperfectly known.

The Size of the Cobra.—In the *Madras Weekly Mail* we find a controversy raging as to whether a serpent shot by a certain "Jungle-wallah" was a cobra (*Naja tripudians*) or a hamadryad (*Ophiophagus elaps*). One writer offers a reward of 25 rupees to any one who can produce a cobra over seven feet in length, whilst the hamadryad reaches double that length. The latter snake, further, inhabits wild forests only, whilst the cobra is equally at home in the city or in the wilderness. The hood of the cobra, with the well-known spectacle markings, is represented in the *Ophiophagus* only by a small dilation of the skin lower down the back, without spectacles. The *Ophiophagus* has, moreover, indistinct yellowish bands across the body. It is clearly established that this snake attacks passers-by without any provocation.

Causes of Variation in Organic Forms.—Professor C. V. Riley (American Association, reported in *Science*) concludes a memoir on this subject by saying, "All that evolution recognises is the transmutability—the generic identity—of the forces of nature, which in their aggregate action may properly be defined as omnipresent energy. We know, as a matter of the simplest observation, that this combined force or energy is essential to the continuance of life, not only upon our planet, but deductively in the universe. We are justified in inferring that it is capable, under fit conditions, of originating life from what we know as non-living matter. Evolution, in fact, inevitably leads to the inference that vital force is transmutable into and derivable from physical and chemical force."

Species of Termites.—Of these insects, twenty-four distinct species are now recognised, nine of which are African, nine American, two Asiatic, and two European.

New Evidence against the Squirrel.—A correspondent of the *Field* records the fact of a squirrel attacking a green woodpecker and disabling it, so that its rescuer had to put the poor bird out of pain. We think that all lovers of birds ought to declare war against this felonious rodent.

Co-operation of Frost and Destructive Insects.—Professor von Ettingshausen observes that trees which have suffered from frost are especially liable to be attacked by the cockchafer (*Melolontha maialis*). Inversely, trees which have been damaged by destructive insects are unusually sensitive to frost.

Reviews.

Report of the Commissioner of Agriculture, 1887. Washington: Government Printing Office.

This report contains a large amount of valuable information on the injuries occasioned by insects, birds, parasitic fungi, etc., and on the means for their repression. Especial attention is due to the experiments on the food of hawks and owls, birds much more useful than is generally supposed. If we leave out of consideration the great horned owl, a bird which no longer occurs in Britain, it will be seen that the food of the remainder consists essentially of mice. For the horned owl little can be said, as his food is almost entirely composed of game and poultry. Even the smaller hawks seem to do more good than harm, since their stomachs were found to contain mice and grasshoppers in profusion.

On the sparrow question we find no new facts, the evidence against this "winged rat" being found so conclusive that no further inquiry is needed. The opinion arrived at is expressed in such phrases as "The best methods of abating the sparrow scourge." The agent recommended is grain or maize meal, fifteen parts of which are mixed with one part of white arsenic. The grain should be moistened with a little gum-water before stirring in the poison. Strychnine or any other poison of rapid action is not recommended, since if one member of a flock falls down dead or is even taken ill, the remainder fly away and never return. The chief objection to this plan is that, especially in severe weather, harmless or even useful birds may be destroyed at the same time. American observers are fully aware of the fact that the "head and front" of the sparrow's offending is that he drives away more useful birds, such as the swallows.

We are glad to see that the badger is recognised as serviceable, as he destroys mice and "gophers."

The Entomologist to the Department has made a number of investigations on destructive insects. Many of his results will be of general value in the British colonies. Mention is made of an epidemic which in 1867 almost extirpated one of the most dreaded enemies of the American farmer, the "chinch-bug" (*Bliosus leucopterus*). It has now, however, reappeared, and is calculated to have last year occasioned a loss to the extent of *sixty million dollars* in nine of the States.

In dealing with aphides, scale insects, a great step in advance has been effected. A so-called "resin compound" is made by dissolving three pounds of common soda-crystals and four pounds of resin in three pints of water over a fire. When properly dissolved, water is slowly added, still boiling, to make up thirty-six pints of liquid. This is then, whilst luke-warm, emulsified with an equal measure of kerosene oil. Arsenic is then added in the proportion of one pound to fifty-five of the compound. This mixture, more or less diluted with water, is driven over the trees infested, and destroys even the "woolly blight" (*Schizoneura lanigera*) of the apple-tree, known in this country as the "American blight." It is said neither to injure the beneficial *syrphus* larvæ, nor the internal parasites of the plant-lice.

Damage has been done both to potatoes and to human beings by swarms of blistering-beetles (*Lytta cinerea* and *Epicauta vittata*). These visitors injured the stems and leaves of the potato-plant in the day, and flying into the houses at night, blistered the faces and hands of the inmates.

Concerning the Colorado beetle, we find that its eggs and larvæ are eagerly devoured by a small carnivorous beetle, *Calcathus gregarius*.

The subject of vegetable pathology and of the fungi which attack crops has received great attention. It can scarcely be denied that the highly specialised plants and trees which we cultivate are more liable to the attacks both of animal and vegetable parasites than was the case centuries back. The vine is, perhaps, more exposed to such enemies than any other crop. The downy mildew, black rot, anthracnose, and root-rot are described as being destructive, and two more diseases—bitter-rot and white-rot—have lately been identified. Very few other fruit-trees entirely escape damage from analogous enemies. Among the remedies which have been used with success are the Bordeaux mixtures (sulphate of copper and lime, dissolved separately) and "Sulphatine." The latter is produced by mixing two and a half pounds of anhydrous sulphate of copper with fifteen pounds of ground sulphur and ten pounds of air-slaked lime.

But were we to call attention to half the important matter contained in this bulky volume we should quite exceed permissible limits.

THE FOUNDATION-STONES OF THE EARTH'S CRUST.

An Evening Discourse delivered by T. G. Bonney, D.Sc., LL.D., F.R.S., F.G.S., etc., before the British Association, on September 10th, 1888.

(Continued from p. 442.)

ILLUSTRATIONS of the effects of direct crushing in a granitoid rock are common in the Alps. Those of a shearing crush are magnificently developed near the great overthrust faults in the north-west Highlands of Scotland.

In the former case, where a granitoid rock has been affected only to a moderate extent, and the resulting rock in a hand specimen would be called a gneiss without any very definite mineral banding, we find that under the microscope it exhibits a fragmental structure, the felspars are often somewhat rounded in outline, are frequently rather decomposed and speckled with minute flakes of white mica of secondary origin, and commonly seem to "tail off" into a sort of stream of microlithic mica, which has doubtless resulted from the destruction of felspar the residual silica making its appearance as minutely crystalline quartz. The original quartz grains have been broken up, and are now represented by smaller grains, often in rudely lenticular aggregates, like little "inliers" of quartzite. The original flakes of black mica have been tattered and torn, and now appear as streaky clusters of flakelets, often less than one-sixth the original length. In extreme cases of crushing, the felspar has almost disappeared; the constituents are all reduced in size, and the rock at first sight would no longer be called a gneiss, but a fine-grained mica-schist. It has become extremely fissile, and the flat faces of the fragments exhibit a peculiar sheen, as if it had received a varnish of microlithic mica. In short, from a granitoid rock a microcrystalline mica-schist has been produced, which, however, differs markedly from the rock to which that name is ordinarily applied.

Let us now turn to a rock of similar nature, in which the effect of shearing is more conspicuous. I have selected a specimen, in which, as in the first example above, some of the felspar still remains in recognisable fragments. These, however, are commonly destitute of the "tail" of mica-microliths, and bear, at first sight, some resemblance to the broken porphyritic felspars which occur in a rhyolite. The mica, whether primary, but fragmental, or secondary, tends to get associated in undulating layers; the quartz also has a more uniform aspect and a more linear arrangement. In the most extreme cases the felspar all but disappears (though I fancy that it has here a better chance of surviving), the quartz and the mica are more and more aggregated in definite but thin bands, and the former, when viewed with crossing nicols, exhibits streaks, which, for a considerable distance, are almost uniform in tint, as if its molecules under a stress definite in direction had acquired a polarity, so that groups of these act upon light almost like a single crystal.

The effects of mechanical deformation, followed by mineral change, are also remarkably conspicuous in the case of pyroxenic rocks. Augite, it is well known, is by no means a stable mineral, and under certain circumstances is readily transformed into hornblende. This occurs in more than one way without mechanical action, but of these I do not now speak. Only of late years, however, has it been known that pressure can convert a dolerite into a hornblende-schist. Of this, through the kindness of Mr. Teall, who first proved the occurrence of this alteration in Great Britain, I can show you an example. The rock has lost the structures of a dolerite, and has assumed those characteristics of many hornblende-schists. I say of many, because though the rock is distinctly foliated it does not exhibit a conspicuous mineral banding. My own observations confirm those of Mr. Teall, though I have never been so fortunate as to obtain, as he did, a complete demonstration of the passage from the one rock to the other.

It seems, then, to be demonstrated, that by mechanical deformation, accompanied or followed by molecular rearrangement, foliated rocks, such as certain gneisses and certain schists, can be produced from rocks originally crystalline. But obviously there are limits to the amount of change. The old proverb, "You cannot make a silk purse of a sow's ear," holds good in this case also. To get certain results you must have begun with rocks of a certain character. So that it is often possible, as I believe, to infer not only the nature of the change, but also that of the original rock. Hitherto we have been dealing with rocks which were approximately uniform in character, though composed of diverse materials—that is, with rocks more or less granular in aspect. Suppose, now, the original rock to have already acquired a definite structure—suppose it had assumed, never mind how, a distinct mineral banding, the layers varying in thickness from a small fraction of an inch upwards. Would this structure survive the mechanical deformation? I can give an answer which will at any rate carry us a certain way. I can prove that subsequent pressure has frequently failed to obliterate an earlier banded structure. In such a district as the Alps we commonly find banded gneisses and banded schists, which have been exposed to great pressure. Exactly as in the former case the new divisional planes are indicated by a coating of films of mica, by which the fissility of the rock in this direction is increased. The mass has assumed a cleavage-foliation. I give it this name because it is due to the same cause as ordinary cleavage, but is accompanied by mineral change along the planes of division, while I term the older structure stratification-foliation, because so frequently, if it has not been determined by a stratification of the original constituents, it is at any rate a most extraordinary imitation of such an arrangement. In many cases the new structure is parallel with the old, but in others, as in the "strain-slip" cleavage of a phyllite, the newer can be seen distinctly cutting across the older mineral banding. As an example, take a rock mainly consisting of quartz and mica. Sometimes there has been a certain amount of crushing of the constituents, followed by a recrystallisation of the quartz and the formation of a pale-coloured mica. Sometimes when the direction of the disturbance has been at right angles to the stratification-foliation the latter is made wavy, and the mica-flakes are twisted round at right angles to their original position. Sometimes there has been a dragging or shearing of the mass, so that a considerable amount of mica has recrystallised along the new planes of division. To put it briefly, I assert, as the result of examining numbers of specimens, that though in certain cases the new structure is dominant, a practised eye seldom fails to detect traces of the older foliation, while in a large number of instances it is still as definite as the stripe in a slate.

We have got, then, thus far, that pressure acting on rocks previously crystallised can produce a foliation; but when it has acted in Palæozoic or later times, the resulting structures can be identified, and these as a rule are distinguishable from those of the most ancient foliated rocks, while at present we have found no proof that pressure alone can produce any conspicuous mineral banding. I am aware that this statement will be disputed, but I venture to plead, as one excuse for my temerity, that probably few persons in Great Britain have seen more crystalline rocks, both in the field and with the microscope, than myself. So while I do not deny the possibility of well-banded rock being due to pressure alone, I unhesitatingly affirm that this at present is a mere hypothesis, a hypothesis moreover which is attended by some serious difficulties. For if we concede that, in the case of many rocks originally granular, dynamic metamorphism has produced a mineral banding, this is only on a very small scale; the layers are but a small fraction of an inch thick. No one could for a moment confuse a sheared granite from the Highlands with a Laurentian gneiss from Canada or with an uninjured Hebridean gneiss. For the former to attain to the condition of the latter, the mass must have been brought to a condition which admitted of great freedom of motion amongst the particles, almost as much, in short, as among those of a molten rock. Clearly the dynamic metamorphism of Palæozoic or later ages appear to require some supplementary agency. Can we obtain any clue to it?

An explanation of broadly banded structures was long since suggested, and has recently been urged with additional force, which avoids some of our difficulties. We know that the process of consolidation in a coarsely crystalline rock has often been a slow one; the constituent minerals separate gradually from the magma, of which sometimes so little may remain that a rock with a true glassy base has been mistaken for one holocrystalline. The residual and still unsolidified magma would admit of a slow flowing of the mass, but there would be so little of it that the crystals already individualised, though altered in position by differential movements, would be affected by strains, and liable to fracture. Such a rock, when finally consolidated, would exhibit many phenomena in common with a rock modified by dynamic metamorphism, but would differ in the greater coarseness of its structure. This may prove to be the correct explanation of the curious foliated and banded gabbros in the Lizard district. That some crystalline rocks must have passsed through this stage I am now in a position to affirm, from evidence not yet published.

Let us, however, see whether another line of investigation may not throw some light on our difficulty. I have already mentioned the effect produced by the intrusion of large masses of igneous rocks upon other rocks. These may be either igneous rocks already solidified, or sedimentary rocks. The former may be passed over, as they will not materially help us. In regard to the latter, the results of contact-metamorphism, as it is called, are, as we might expect, very various. Speaking only of the more extreme, we find that sandstones are converted into quartzites; limestones become coarsely crystalline, all traces of organisms disappearing, and crystalline silicates being formed. In clayey rocks all signs of the original sediments disappear, crystalline silicates are formed, such as mica (especially brown), garnet, andalusite, and sometimes tourmaline; felspar, however, is very rare. Fair-sized grains of quartz appear, either by enlargement of original granules or by independent crystallisation of residual silica. It is further important to notice that, as we approach the surface of the intrusive mass—that is, as we enter upon the region where the highest temperature has been longest maintained—the secondary minerals attain a larger size and are more free from adventitious substances—that is, they have not been obliged as they formed to incorporate pre-existing constituents. The rock, indeed, has not been melted down, but it has attained a condition where a rather free molecular movement became possible, and a new mineral in crystallising could, as it were, elbow out of the way the more refractory particles. I can, perhaps, best bring home the result of contact-metamorphism by showing what its effects are on a rock similar to that which I exhibited in illustration of the effect of pressure-metamorphism on a distinctly stratified rock. These are, in brief, to consolidate the rock, and while causing some constituents to vanish, to increase greatly the size of all the others. It follows then that mineral segregation is promoted by the maintenance for some time of a high temperature, which is almost a truism. I may add to this that, though rocks modified by contact-metamorphism differ from the Archæan schists, we find in them the best imitations of stratification-foliation, and of other structures characteristic of the latter.

One other group of facts requires notice before we proceed to draw our inferences from the preceding. Very commonly, when a stratified mass rests upon considerably older rocks, the lower part of the former is full of fragments of the latter. Let us restrict ourselves to basement beds of the Cambrian and Ordovician—the first two chapters in the stone-book of life. What can we learn from the material of their pages? They tell us that granitoid rocks, crystalline schists of various kinds, as well as quartzites and phyllites, then abounded in the world. The Torridon sandstone of Scotland proves that much of the subjacent Hebridean had even then acquired its present characteristics. The Cambrian rocks of North and South Wales repeat the story, notably near Llynfaelog in Anglesey, where the adjacent gneissoid rocks from which the pebbles were derived, even if once true granites, had assumed their differences before the end of the Cambrian period. By the same time similar changes had affected the crystalline rocks of the Malverns and parts of Shropshire. It would be easy to quote other instances, but these may suffice. I will only add that the frequent abundance of slightly altered rocks in these conglomerates and grits appears significant. Such rocks seem to have been more widely distributed—less local—than they have been in later periods. Another curious piece of evidence points the same way. In North America, as is well known, there is an ancient group of rocks to which Sir W. Logan gave the name Huronian, because it was most typically developed in the vicinity of Lake Huron. Gradually great confusion arose as to what this term really designated. But now, thanks to our fellow-workers on the other side of the Atlantic, the fogs, gendered in the laboratory, are being dispelled by the light of microscopic research and the fresh air of the field. We now know that the Huronian group in no case consists of very highly altered rocks, though some of its members are rather more changed than is usual with the British Cambrians, than which they are supposed to be slightly older. Conglomerates are not rare in the Huronian. Some of these consist of granitoid fragments in a quartzose matrix. We cannot doubt that the rock was once a pebbly sandstone. Still, the matrix, when examined with the microscope, differs from any Palæozoic sandstone or quartzite that I have yet seen. Among grains of quartz and felspar are scattered numerous flakes of mica, brown or white. The form of these is so regular that I conclude they have been developed, or at least completed, *in situ*. Moreover, the quartz and the felspar no longer retain the distinctly fragmental character usual in a Palæozoic grit, but appear to have received secondary enlargement. A rock of fragmental origin to some extent has simulated or reverted to a truly crystalline structure. In regard to the larger fragments, we can affirm that they were once granitoid rock, but in them also we note incipient changes such as the development of quartz and mica from felspar (without any indication of pressure), and there is reason to think that these changes were anterior to the formation of the pebbles.

To sum up the evidence. In the oldest gneissoid rocks we find structures different from those of granite, but bearing some resemblance to, though on a larger scale than, the structures of vein-granites or the surfaces of larger masses when intrusive in sedimentary deposits. We find that pressure alone does not produce structures like these in crystalline rocks, and that when it gives rise to mineral banding this is only on a comparatively minute scale. We find that pressures acting upon ordinary sediments in Palæozoic or later times do not produce more than colourable imitations of crystalline schists. We find that when they act upon the latter the result differs, and is generally distinguishable from stratification-foliation. We see that elevation of temperature obviously facilitates changes, and promotes coarseness of structure. We see also that the rocks in a crystalline series which appear to occupy the highest position seem to be the least metamorphosed, and present the strongest resemblance to stratified rocks. Lastly, we see that mineral change appears to have taken place more readily in the later Archæan times than it ever did afterwards. It seems, then, a legitimate induction that in Archæan times conditions favourable to mineral change and molecular movement—in short, to metamorphism—were general, which in later ages have become rare and local, so that, as a rule, these gneisses and schists represent the foundation-stones of the earth's crust.

(To be continued.)

Abstracts of Papers, Lectures, etc.

JUNIOR ENGINEERING SOCIETY.

At the opening meeting of the eighth session, which took place on October 12th, the presidential address was delivered by Professor W. Cawthorne Unwin, F.R.S., M.Inst. C.E., on "Illustrations of the Use of Theory in the Work of the Engineer." After some introductory remarks from the chairman, Professor Unwin said that the name of the society suggested to him that he might venture to speak to them as an older to younger engineers. He began work as an engineer more than thirty years ago, and they could hardly imagine with what scanty means of attacking the problems before them they were provided with at that period in the days before Rankine.

Nevertheless, it was pleasant to look back and to remember that one saw the birth and development of so many of the processes, the improvement of so many of the machines, the invention of so many of the structures, the use and construction of which was now the ordinary business of the engineer. Nothing was so striking in looking back on the history of engineering during the last thirty or forty years as the growth in connection with the practice and business of engineering of a body of scientific principles forming a science of engineering. The engineer had in part acquired and in part discovered the scientific principles applicable to his daily work. Purely scientific men, whose experience was confined to the laboratory, were apt to forget that a large part of the work of an engineer was nothing else than experimenting on a very large scale, and, to tell the truth, with very heavy penalties in most cases for failure. Not seldom the engineer's researches extended far beyond immediate practical interests, and were carried out in a spirit as truth-loving as any laboratory experiments. They still heard of an opposition of science and practice. If, however, they would concede the dependence of practical engineering on a body of scientific principles forming a theory of engineering, he would ask their attention first to the subject of technical education. The derivation of the word engineer showed that an engineer was recognised as a man who worked with his brain, not with his hands. Of course, in the business of engineering there were engaged a large body of artisans whose value depended on their skill of hand, and he had the greatest respect for the work they did. Most of them had, no doubt, noticed two remarkable articles on technical education, by Lord Armstrong and Sir Lyon Playfair. Lord Armstrong wrote on the vague cry for technical education, and showed an obvious distrust of some things which were advocated in that name. Sir Lyon Playfair replied that he failed to see to what exactly Lord Armstrong objected, and that he was throwing cold water on efforts beginning to bear useful fruit, and promising to have an influence of the widest kind on the national welfare. It was clear that in Lord Armstrong's article he was thinking almost exclusively of the education of the artisan class, and concerning that class it was further clear that Lord Armstrong was in no way opposed to their general education; but where Lord Armstrong stopped, and became doubtful or hostile, was at attempts to give in school the specific training in a handicraft or trade which hitherto had been gained directly in the shop. He thought Lord Armstrong wished well to any increase of intelligence in workmen, but doubted—and he (Professor Unwin) was disposed to agree with him—that scientific training would make men better workmen. They who were engineers could understand very well how impossible it was to train the vast number of fitters or boiler-makers or other artisans connected with engineering anywhere else than where large and heavy actual work was going on. Sir Lyon Playfair, he thought, did not fairly meet Lord Armstrong on this point, and did not very distinctly keep clear general education and special technical education, nor sufficiently mark the difference between the means necessary for acquiring the skill of hand of the craftsman, and those suitable for educating the brain-workers who did the thinking and designing in all constructive industry. For the young engineer Professor Unwin thought that regular and systematic technical instruction in the strictest sense was needed, and it was through these that advanced scientific teaching might come to have a real and powerful influence on the maintenance of our mechanical superiority—and so on the welfare of the country and of every classs in it. However good a school for the workman, the shop was a most imperfect school for the engineer. The value of acquiring handicraft skill in the case of the engineer was easily overrated, and the long time spent in the workshop involved in one direction a good deal of loss. During years at the bench much of school knowledge of science and mathematics disappeared. He thought that Lord Armstrong a little underrated the need of college training for engineers. There were two ways in which a technical college and the engineers in practice might work together with mutual advantage. One was that they might, without interfering with the apprenticeship system, give facilities to apprentices to make use of the college, so that the workshop training might be supplemented by scientific training. The other was that they might give some small advantages to young men who had had a technical training at that difficult point in their career at which they first entered on practical life. If in any way they could attain a system by which the theoretical education went on *pari passu* with the practical education, and that without sensible interference with the ordinary apprenticeship, it would be a good thing. It appeared to him that engineers might, without sensible harm to the rules of the workshop, spare apprentices for one day a week to attend a course of instruction in college. Evening instruction after shop hours was too scrappy and disjointed to do much good. But instruction carried on systematically through one clear day a week would be much more valuable. Professor Unwin then referred to a remarkable paper by Mr. Thomson, one of the most distinguished of American bridge builders, which seemed to throw doubt on any reliance on theory in practical engineering, and who, in support of his contention, stated that during the past ten years 250 American iron bridges had completely broken down. They must not take too literally Mr. Thomson's view—meant, probably, half humorously—that American bridges failed because they were built too scientifically. As an example of what he thought were right and wrong ways of theorising, he referred to the question of the collapse of boiler-flues, and with the aid of diagrams made some valuable and interesting remarks from a technical point of view on that subject.

Liverpool Science Students' Association.—At the opening meeting, held on October 16th, Miss E. N. Wood gave a *résumé* of the botanical work of the summer session. The President (Mr. Osmund W. Jeffs) then delivered the annual address, which dealt mainly with the geology of the Cheshire hills.

St. John's Natural Science Society, Upper Holloway.—On Tuesday, October 16th, a very interesting lecture on "Leaves" was delivered to the members of this society by Mr. J. McKerchar. The subject was illustrated by means of diagrams, dried specimens, growing plants, and by a series of excellent microscopic preparations.

The Microscopical Society of Glasgow.—At the usual monthly meeting of this society, held on October 16th, Mr. C. Fred Pollock, M.D., gave a concise and comprehensive description of the human skin, with its various layers, glands, muscles, and appendages, such as hairs and nails.

THE BEATING OF THE HEART.

FEW of the marvellous phenomena of our own physical life excite our curiosity so early or so keenly as the throbbing of the heart in the breast. The child speculates as to the cause and object of this rapid and incessant pulsation, and only gives up his inquiry because the problem is too hard. The expert physiologist spends a working life in getting to understand fully and experimentally little bits of the driving engine of the blood-circulation. Toil as he may, the explanation never grows perfectly simple. Special facts, gradually seen to be important, but at first sight irrelevant or superfluous, break up that easy and luminous theory which is still hoped for, never found. Perhaps it is not untrue to say that the more the heart is studied, the harder it is to understand.

We shall only succeed in giving the reader a clear view of the cardinal facts by leaving out altogether a host of recorded details which the working physiologist is bound to keep steadily in view. Let us attempt to answer but two questions—

1. How is it that the heart never becomes fatigued?
2. How is its rhythmical beat kept up?

The simplest answer to question 1 is that the heart *does* become fatigued. Indeed, it becomes fatigued very quickly, but recovers itself after a very short rest. We have heard of men who undertake for a wager to walk 1,000 miles in 1,000 hours. The heart undertakes to contract, say, 5,000 times in an hour. It becomes fatigued, and rests after each contraction, and this interval of fatigue is in itself enough to occasion a certain kind of rhythmical action, of which examples could be quoted. The motive power is put forth in response to stimulus, and is exhausted in a moment. A short spell of rest enables the stimulus to provoke a fresh contraction. This leads us to ask where the motive power is stored up. The answer is furnished by experiment upon a fresh-killed frog. Cut out the heart; it still continues to beat. Cut it across just below the line which marks the junction of the ventricle with the two auricles; the upper half continues to beat, but the lower half is paralysed. Divide the upper half into two; each quarter continues to beat. There must therefore be motive centres within the heart sufficient to keep up pulsation. Indeed, by a somewhat difficult and minute dissection these centres can be found. They are minute ganglia, or groups of nerve-cells.

Given ganglia in communication with the muscular fibres of the heart, a rhythmical contraction at once becomes possible. Some stimulus, *e.g.*, the pressure of blood in the auricles, excites the ganglia. These stimulate the muscles, contraction follows, and the impulse is spent. The nervous force has been discharged, and requires time for recovery. The muscular force has also been discharged, and requires time for recovery. It is probably in this very simple way that detached organs which contain ganglia are occasionally seen to beat. A frog's tongue, the foot of a fresh-water mussel, or a small strip of the bell of a jelly fish may pulsate after removal from the body, provided that it contains a ganglion in communication with muscular fibres. It is possible, though not proved, that the muscular fibres of the intestine, and the muscular fibres of the heart in various animals of low grade, may keep up their peristaltic action in the same way.

But in all hearts which have been carefully and experimentally studied a more complicated piece of machinery is added. This takes the form of an inhibiting nerve, which checks the ganglion before its force is wholly spent. Inhibition is just as effective as fatigue in keeping up a rhythmical movement. The sequence now becomes—(1) stimulation of the cardiac ganglia; (2) the overpowering by accumulated stimulus of the inhibiting force; (3) discharge; (4) renewed inhibition.

In higher animals the inhibiting nerve is a long nerve, called the pneumogastric, which traverses the neck and originates in the medulla oblongata, at the back of the brain. Irritation of the pneumogastric by an interrupted electric current, pressure, or chemical stimulation may be made to produce a long-continued stoppage of the heart. Čzermak was able to stop his heart at pleasure by pressing this nerve against a small bony tumour in his neck. The regulation of the rate and force of the heart's beat is by means of the pneumogastric transferred to the brain, and brought into relation with what is going on in distant parts of the body. If the body of a frog is laid open, and a light but smart blow is given to the intestine, the heart will stand still. But if the medulla or both the pneumogastric nerves have been previously destroyed, no such effect follows. It was the impulse transmitted to the medulla from the intestine which stimulated the inhibitory nerve, but when the nervous path is broken the heart is altogether out of relation with the intestine.

Czermak (*Physiologische Vorträge*, I.) has devised a model which enables the student to gain a clear idea of the combined effect of stimulus and inhibition in producing rhythmical motion. A stream of water, regulated by a tap, descends upon what he calls a boat. This boat is poised upon an axis. It has a flat base, and a partition across its middle, at right angles to the two triangular sides. At starting the boat is tilted up, one of its two compartments being turned upwards, while the other rests upon an adjustable support. The stream flows into the upper compartment, and fills it to the point at which it counterbalances the other. Then the boat capsizes, and empties itself. The other compartment now begins to fill, and so on. It is a pretty enough sight to see the boat oscillating by the action of a constant stream of water.

In this model we have a cause of movement—viz., the stream of water, and a cause of stoppage—viz., the support beneath, which checks the fall of the boat. The joint effect of the motive and restraining forces is a rhythmical action. If the fall is increased by lowering the support beneath the boat, the oscillation becomes slower and more forcible. If the support is raised the oscillation becomes quicker and weaker. Increase or diminution of the stream affects the rate, but not the force, which is entirely determined by the amount of fall. The model gives us, therefore, four possible combinations of rate and force. The oscillations may be (1) *strong—quick*, (2) *strong—slow*, (3) *weak—quick*, (4) *weak—slow*, and the very same combinations are met with in the pulse. It is not too much to say that Czermak's model is a trustworthy guide to the cause of each variation.

Into other details of the movements of the heart we shall not enter at present. The student or teacher who will make Czermak's boat, and master its analogy with the pulsating heart, has won a solid foundation for further observation and reflection.

THE AUSTRALIAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

The President's Address.

THE inaugural meeting of the Australian Association for the Advancement of Science was held in the Great Hall of the Sydney University on Aug. 28th.

After a few opening remarks from Lord Carrington, who presided, Mr. H. C. Russell delivered the presidential address. After referring at some length to the history of the British Association, he said: At the very time that Sir David Brewster was using his pen and his influence to stir up the scientific men of England to greater effort in the cause of science, and to the formation of the British Association for the Advancement of Science, the British Government were sending to Sydney one of the most energetic scientific men that ever set foot upon Australian soil, with a view of keeping alive the dying embers of the first attempt to plant science in this part of the world. And I think it most fitting that, at this first meeting of the Australasian Association for the Advancement of Science, we should remember that first effort to promote science in a country so remote from the homes of science. It is difficult now to form any idea of the condition of society in Australia when Sir Thomas Brisbane landed, and nothing but the habit of disregarding difficulties, which a long military experience had taught him, would have made it possible in his mind to form a scientific society under such circumstances. But he had been so accustomed to go into strange places and make his own surroundings that it appeared to him possible to do the same here. He landed in the end of November, entered upon his official duties on December 1st, 1821, and by January 2nd following he had found out the only scientific men in the colony, formed them into the Philosophical Society of Australia, and had the first paper read. He never seems to have anticipated any difficulty in managing this handful of civilians, who, however, soon got beyond his control. His own enthusiasm for science was very remarkable. In the midst of the harassing marches and all the perils of the great Continental war in which he bore a part, even when he had to sleep six nights in the snow with nothing but his overcoat to cover him, and found himself frozen to the ground each morning, and once with 900 men frozen to death around him, he always had his astronomical instruments in his baggage, and brought them into use whenever there was half a chance. It was this intense love for science, coupled with his military ideas, which made him so anxious to get all the scientific men around him in a duly organised society, each to do his duty rigidly or suffer the consequences. But with all his enthusiasm he soon found that a small army of scientific workers was not so manageable as the armies he had been accustomed to. The members of this first Australian society, according to Judge Field, were Alexander Berry, Henry Grattan Douglas, M.D., Baron Field (Judge), Major Goulburn (Colonial Secretary), Captain Irwin (Bengal N. I.), Captain P. P. King, John Oxley (Surveyor-General), Charles Stargard Rumker (astronomer), Edward Wolstencroft, his Excellency Sir Thomas Brisbane, K.C.B., F.R.S. (President). I find no record of the rules of this society, excepting one, and that was if a member failed to read a paper when his turn came he forfeited £10. They met at each other's houses in turn, and the only refreshment allowed was a cup of coffee and a biscuit. It seems that the society was more of a mutual friendly association or scientific club than a formal society. At that time there was no public library, and but one bookseller for the whole of Australia, so the members catalogued their books and lent them to members. With such a strong incentive to write papers, there can be no doubt that meetings seldom lapsed for want of a paper, but they were not published in proceedings, and the only existing record is given by Judge Field, who published four of them in his "Geographical Memoirs"—(1) "On the Aborigines of New Holland and Van Diemen's Land," read January 2nd, 1882. (2) "On the Geology of Part of the Coast of New South Wales, from Hunter River to the Clyde," read in the same year by Alexander Berry. (3) "On the Astronomy of the Southern Hemisphere," by Dr. Rumker, read March 13th, 1822. (4) "On the Maritime Geography of Australia," by Captain P. P. King, R.N., read October 2nd, 1822. Mr. Oxley also read a paper, and Major Goulburn some notes on meteorological observations; and lastly, Sir Thomas Brisbane communicated meteorological observations. We have evidence, therefore, that seven at least of the twelve were workers. Allan Cunningham (botanist) also contributed papers to Judge Field's memoirs—one describing his travels from Bathurst to Liverpool Plains in 1823, and the second on the botany of the Blue Mountains, as observed in November and December, 1822. Judge Field does not say that these papers were read to the society, so that he may not have been a member, but without doubt all the members did good service in the colony. The society which was thus commenced with such flattering promise of usefulness was destined to but a brief period of existence. A question arose between the Government and some of the members as to the value of the dollar—the coin then current—which led to estrangement aud the breaking up of the little band of workers who cultivated science. It appears that this was caused by the decree that the dollar, after the centre had been punched out to make a small coin equal in value to sixpence and known as a "bit," should still pass for its original value, the effect of which was severely felt by business people, because it raised the value of the pound sterling 25 per cent. But the great work which Sir Thomas did in Australia, and what I am disposed to think induced him to accept the position of Governor in the distant colony, was his astronomical work. He had applied before taking the appointment for the consent of the Government to start an observatory when he got to Sydney, but that being refused, on the ground that they were then making arrangements to establish an observatory at the Cape, and did not think it necessary to have two southern observatories, he at once determined to take the whole cost and responsibility upon himself, purchased a complement of instruments, and selected two assistants—Dr. Rumker, as a first-class astronomer and mathematician, and Mr. Dunlop, for his great natural ability and enthusiasm in the pursuit of astronomy. He brought the whole with him, astronomers and instruments landing in Sydney in November. The observatory was at once marked out, within 100 yards of Government House, Paramatta, so that he could at any convenient time take a share in the work; but he could not wait for the building. I find, from the observations, that he observed the sun's solstice in December, and he so hurried on the building that it was completed and ready for use by the end of April. He, with both assistants, worked at high-pressure observing until June 16th, 1823, when Mr. Rumker, owing to some difference in opinion between himself and Sir Thomas, left the observatory. Dunlop at this time was not a trained astronomer, but he was a ready learner, and a little training from Sir Thomas made him master of the instruments, and then he began that well-known feat of observing which probably has never been equalled. By the end of February, 1826, or in two years and eight months, he made 40,000 observations, and so catalogued 7,385 stars. He then left the observatory, and in sixteen months at his own house in Paramatta he catalogued 621 nebulæ and clusters of stars, made drawings of the Milky Way, Nebeculæ, major and minor, and many nebulæ, catalogued and measured 253 double stars. For this he got the gold medal of the Royal Astronomical Society, and afterwards gold medals from the Royal Institute of France and from the King of the Belgians. Meantime Rumker had returned to the observatory, and agreed to carry out a work that was recommended by Sir Humphry Davy as President of the Royal Society, viz., the measurement of an arc of the meridian in New South Wales (that arc is not measured yet). Sir Humphry Davy urged that "the measurement of an arc of the meridian in New South Wales would not only be of importance to astronomy in affording data for determining correctly the figure of the earth, a matter of great interest to navigation, but would likewise be useful in laying the foundation for a correct survey of our colonies in that great and unexplored country" (dated 20th October, 1823). Five years later, in 1828, things had made some progress; Mr. Rumker had agreed to measure the arc, and he ordered the apparatus; but in January of the following year, 1829, he again left the observatory, and that for the time was an end of the arc of the meridian proposal. Dunlop was reappointed in 1831, and the observatory lingered on without publishing until 1840, when it was dismantled. One cannot look back at the history of that observatory without pain, owing to the misfortunes which seemed to upset every effort to make it useful. Sir Thomas was evidently a first-class observer with the sextant, but knew nothing of fixed instruments; hence he bought a lot of instruments second-hand, and wholly unfit for the work they were intended to do. Sir Thomas Brisbane had the command of men and means in abundance, the will and the ability to direct, and so all but the two little ifs was ready for the measurement of an arc of the meridian—a work too long left undone, and one which I hope this association will take up, not with its funds, but with its influence, and urge on to completion. It is a work of the greatest scientific and practical importance. The four great colonies interested in this question have each done a part of the work which will be allotted to them when the arc, which must extend from the south to the north of the continent, is finally measured; and if this association rightly uses its influence the work will be done. At present our surveys are quietly going on upon the assumption that the earth is a regular spheroid, when it is more than probable, from the arrangement of land and water, that it is nothing of the sort at this particular part of its surface. Sir Thomas Brisbane evidently contemplated this when he left England, for he took with him the pendulum apparatus to determine the figure of the earth, and left his friends in England to bring the necessary pressure to bear upon the Government to get the arc measured under his administration. I have introduced the subject here as one in every way suitable to occupy the attention of the association, or at least one section of it, and I thought the early history of the conception would be new to most of us. And its author is in every respect well worthy of remembrance at our first meeting. He was the first man who can fairly be called a patron of science in Australia, having spent, in furnishing the observatory alone, without salaries, more than £1,600. He was the first to form an association of scientific men in Australia, with a view of advancing science, and Sir John Herschel justly said of him, when presenting the gold medal of the Royal Astronomical Society for the Paramatta catalogue, "It will be to you a source of honest pride as long as you live to reflect that the most brilliant trait of Australian history marks the era of your government, and that your name will be identified with the future glories of that great colony in ages yet to come, as the founder of her science. It is a distinction worthy of a British governor. Our first triumphs in those fair climes have been the peaceful ones of science, and the treasures they have transmitted to us are imperishable records of useful knowledge, speedily to be returned with interest to the improvement of their condition, and their elevation in the scale of nations." Amongst the eleven men who formed the first scientific society of Australia there was far more than an average amount of ability. The great weakness of the society, and that which made it impossible for it to exist except under the fostering care of the Governor, was its want of numbers; and unfortunately, in many branches of science the same difficulty exists to-day, and makes it always difficult, and in some sciences impossible, to keep alive societies for their promotion only. Even in those societies which include a number of subjects, and thereby add to their numbers the workers in each, it is often difficult to find enough original work, and perhaps I ought to say enthusiasm, to keep a healthy amount of vitality at its meetings. I am sure there are many here present who have to do the work of scientific societies who must have felt this, and who have often wished, as I have, for something to put a little additional vitality into the members, and for something, also, which would bring together a greater number of workers in each branch of science, so that ideas might be interchanged, and a little healthy emulation aroused. Not something to withdraw members from their own societies and steady work, but something to make us feel that it will not do to go to sleep, because our fellow-workers in the other colonies are very wide awake. The Australian Association for the Advancement of Science seems to me to meet our case exactly. Its meetings only last for one week in each year, and therefore cannot take members from their local societies, and by assembling the workers in each branch of science from all the colonies, by asking them to form committees and work side by side for a time, it promotes the exchange of ideas upon the same subject, and the pleasure which that affords. There can be no more fitting time to explain the steps which have led up to our Association for the Advancement of Science than this, our first meeting, when I hope all the members are present. I have no doubt that to very many the information will be new, and under any circumstances we must leave for those who come after us an account of the origin of an effort in the cause of science which I am sure will have an important and lasting influence on the scientific progress of Australia. The first step was taken by Professor Liversidge, who is himself an institution for the advancement of science, and knows no fatigue in that service. Round him everything has revolved in perfect order to the complete preparation for this meeting. On September 16th, 1884, in a letter to the *Herald*, which was afterwards reproduced by most of the colonial and some of the home papers, he pointed out that the interest created in Australia by the announcement at the British Association meeting in Montreal of Mr. Caldwell's discovery of the oviparous nature of the platypus and porcupine had led to the suggestion that they should meet some day in Australia, but that he thought this was improbable at present, owing to the time it would take and the cost, and he suggested that we should make preparations for the realisation of the proposal by bringing about a federation or union of the members of the scientific societies of Australia, Tasmania, and New Zealand into an association on the lines of the British Association, and that the first meeting should be in 1888, as one of the features of the Centennial year. He had previously, viz., in 1879, mentioned the proposal to a few, but thinking matters were hardly ripe to press it, he had not gone further. Nearly two years then elapsed, and no one took up the suggestion, so in his address as President of the Royal Society in May, 1886, he said, "I am still of opinion that arrangements should be made for holding a meeting of those who wish to form an Australasian Association in 1888, and I shall be glad if those who are in favour of it will kindly send me their names." "If the proposed Australasian Association for the Advancement of Science should really become an accomplished fact, as I hope it will, the first meeting should, I think, be held in 1888," and he then sketched an outline of the rules for it, based on those of the British Association. On June 30th, 1886, came the first support to his proposal; the Council of the Royal Society of New South Wales resolved to take a part in furthering these views, then promises of support came in from the other colonies. Thereupon in July, 1886, he sent a circular to the presidents of the various Australasian societies, telling them that his proposal had been favourably received, and requesting them to appoint members of their council or delegates to represent them at a meeting of such delegates from various societies as soon as possible. The number of representatives or delegates from each society was to be one for each 100 members. On July 28th, 1886, the Royal Society of New South Wales appointed five delegates; thirty-four other societies agreed to join, and twenty-eight appointed delegates for the meeting, which was called for 10th November, 1886. At the meeting sixteen delegates were present—seven from New South Wales, two from New Zealand, two from Queensland, five from Victoria. They framed and adopted the provisional rules which we now have, and which are the British Association rules altered to suit our circumstances. It was resolved that the president, hon. secretaries, and hon. treasurer should be elected by ballot from the representatives of the colony in which the meeting is to be held, and the presidents of sections from members in the other colonies, and that the first election shall be held in Sydney in March, 1888; and further, that the first meeting should be held in the beginning of September, 1888, in Sydney. Special appeal was then made in the daily press to all who intended to join the society to send in their names, so that they might be eligible for election to the official positions, officers for which had to be elected by ballot, and the elections were delayed as long as possible to give every one time to join. The delegates were called together, and met on March 7th, 1888, and they elected—H. C. Russell, F.R.S., President; Prof. Liversidge, M.A., F.R.S., and Dr. George Bennett, F.L.S., Hon. Secretaries; and Sir Edward Strickland, K.C.B., Hon. Treasurer. Since then the council, composed of the delegates from the various societies taking part in the work, have held 13 meetings, and have found plenty to do in arranging the details for the meeting, electing vice-presidents, presidents, and secretaries of sections, collecting papers to be read, etc., for this meeting, and have caused to be sent out 6,000 circulars to members of scientific societies in Australia; they have, in fact, been sent to every member whose address was known to them; and thinking it possible that there were many others who would join an association with such a wide basis, they have appealed to the public through the daily papers of all the colonies very frequently, by advertisement and paragraph, and the result is that to-day our numbers are 750, which, I think, is very satisfactory and encouraging. I may mention that in Australasia there are only 38 scientific societies known to the officers of this movement. All these were appealed to by letter; 34 expressed their ntention of taking part in it, and of these 28 sent representatives to the meetings—this out of a population which may be roughly stated at 4½ millions. In 1831, when the parent society was formed, the population of the United Kingdom was 23 millions, and there were in existence 39 scientific societies (I am unable to say what was the number of members). I have endeavoured thus briefly to sketch the history of the movement which has resulted in the present association. Like the British Association, our basis is broad enough to take in "whatever desire there may be in the country to promote science," and those who have joined hope that no man will stand aloof who has any desire to help in the advancement of science. After the experience gathered by a similar institution in the old country, I have no fear for the future of this movement. I do not expect the association to emerge from the shell of its first meeting perfect; that would be unreasonable; but I believe that we have accepted a constitution and acquired an impulse which in the course of time will lead us on to the realisation of our purpose. The scientific man works very much alone, isolated from those around him by his peculiar manner of life, and from his fellow-workers by distance, because so far the world expects each scientific man to be a world in himself, to be able to do all it wants of that science, and is not disposed to keep several where one can be made to do. The call of the British Association, therefore, to meet once a year those who are like-minded, appeals to his social instincts in a very effective way. Hence the opportunity of going to the meeting to see and talk with his fellow-workers is not to be lost. It is a real pleasure to have a talk with kindred spirits, and a very effective motive for application all through the year, for no man would choose under such circumstances to neglect his self-culture, and feel at the meeting that he was far behind his fellows. Then these meetings naturally lead to the formation of committees, who must work up all those subjects which the individual cannot manage. One of our first duties will be to work up all the facts known in every branch of Australasian science, if you will allow me to use the term. I mean all those branches of science which are more immediately connected with the material advancement of the colonies. This I hope will not take long, and then we shall be in a position to advance in these subjects. Every worker knows how necessary it is to have all facts in clear and orderly arrangement, as a preliminary and necessary step to any safe advance. It may seem to some that I am asking too much—that we are all hard-worked men, and but few in numbers, and have no time for such work; but exactly the same may be and has been said of the men who are the workers in the British Association, yet they are not the men of leisure, but the busy men of science, who do the work, and it is very instructive to watch how they respond to the call of the association; it comes like a call to arms that must be responded to, and is responded to often at great personal sacrifice, and with no other motive than loyalty to the cause they serve. But the parent association has just the same power over hard-worked professional and business men; in thousands of cases it has taken from such a man a week of ill-spared time during which he attended the meetings, and by so doing has succeeded in setting him to work for a year, thinking how he can advance the cause of science. As like produces like, so these meetings of workers make many new workers; and as we read down the list of names of those who have been drawn into the great army of workers we find the name of every distinguished man in the United Kingdom—men with a practice or business in which they had no spare moments; Stephenson, Scott Russell, Brunel, Bessemer, Nasmyth, Armstrong, Warren de la Rue, Spottiswoode, Whiteworth, Siemens, and so on, through all that grand muster roll of which any nation would be proud. Now, I do not for one moment suppose that we with four millions can make the same display of talented workers that the United Kingdom can from thirty-seven millions; but we can find some, and I am quite sure that our association will be the means of bringing to the front many men amongst us, now scattered through the country, who have ability and genius, and who are willing to take up some of the subjects which require investigation and work them out; men whose daily work is of another kind, but who have nevertheless a keen love for science and investigation and the spare time to take up a limited subject and fill up the whole detail. I am convinced that there are many such who require no other stimulus than that of being invited to render services of the highest order. They want to work, but do not know where to begin; while, on the other hand, a crowd of suggestions meets the busy scientific worker at every turn. Ideas that want realising are continually floating in his thoughts. Now it is some promising line of investigation, some experiments that only want making to put the finishing-touch to a long line of reasoning, and establish some new scientific fact or some new law of nature. Now it is a new view of an old and well-fought difficulty, some new vantage-ground that promises success; but he cannot leave the pressing duties of the present hour to work out the promising future. And for him to meet those who have time and ability to work is like hope in the wilderness, and if our association can bring them together it will have done much to promote science. It has been said that amateurs at science do little in the more difficult subjects of investigation; but those who say so overlook the fact that when a man does do difficult work they cease to call him an amateur, and class him with professional men. It is a well-known fact that some of the greatest honours in scientific work were won, and are being won, by men who would be properly classed as amateurs—men who have stolen from leisure and from sleep the hours necessary for their favourite study. It is a mistake to class all amateurs as alike. As well say that all business men are alike. Science seems ever to point forward. The question answered to-day suggests two for to-morrow. There may be no halting-place, and none is desired. Obedience to the law of service develops into a service of love, and the search for truth is the pleasure of existence. And if we are true to our colours we we will see that truth is not stored away in dusty papers, but published to the world, so that every one may see what and how it is. The British Association has put the best men to do this, and to publish the known facts in every science to the world, and has found this the best method of helping that great majority who are ready and willing to help if taken up to the front and shown clearly the boundary between what is known and what is unknown. It is this noble example that we wish to follow. The Australian Association is for the advancement of science, and if it fails in that it will fall to pieces. But it is not the hobby of a few individuals or of one colony; it takes in all who wish to advance science in all the colonies it meets here this year—in Melbourne, probably, next year, going to another colony every year, gathering up the enthusiasm of each colony in turn, and will come back to us when we are very glad to receive it. By its charter the association is bound to promote the intercourse of scientific men and lovers of science; to give a stronger impulse and a more systematic direction to scientific inquiry; to obtain a public recognition for the claims of science, and to endeavour by every means in its power to promote scientific inquiry; to grapple with the scientific questions that affect the material advancement of this portion of the British dominions—questions in chemistry, physics, and geology; in mining, mineralogy, and engineering; in meteorology, water conservation, and irrigation; and every other subject that may promote our national advancement. I hope you will not think my subject is running away with me, for the experience of the British Association fully justifies us in believing that we may expect all this and much more from our association. We are often told of the influence of science upon material advancement; but there is another thing that I should like to dwell upon, but that I fear to keep you too long. We hear too little about the influence that scientific work has upon a man's character. There is a science culture as well as a classical culture, and it would be worth while tracing its influence upon those who get it, and through them upon society. And we hear far too little about the influence which science is having upon the young, by exercising their powers of observation and reason on the phenomena of nature around them. Scientific education is spreading through all classes of the community, and slowly, but surely, like the advance of every great truth, the world has learned to recognise the fact that science is the great lever in the material advancement of the people; nay, more, that we cannot have material advancement without a previous advance in science. If we are to have new processes in the arts, new applications of the laws of nature for the wellbeing of mankind, we must first have the study of nature and the laws which govern its operations before we can hope to employ them for our advantage. In a new country like this, with all its local variations in the laws of nature, its uncultivated forest fruits and flowers, its unknown vegetable and mineral wealth, the fact is forced upon us in a thousand ways that we must know or we must suffer. And we use the word science in its comprehensive sense. There have been those who said that the proper study of mankind is man, and who, while strenuously denying to this study the dignity of a science, have thought no other science worthy of culture. And there have been others who have asserted that man's only study was nature in the things around him, neglecting altogether the science of man. But man and nature are correlative, and therefore true science must embrace both studies. And even in the things around us we must not take the vulgar view, which only sees the necessity for cultivating those branches of science that are direct producers of gold and minerals. As a well-known politician in another colony once said to me when I asked him to spend a few pounds on pure science, "Will it affect the price of beef and mutton? If not I won't spend a shilling on it." Unfortunately he is not alone in his opinion; there are many whose only measure for scientific value is a coin of the realm. If there is to be a true advance of science it will not come from one-sided efforts. Each branch must be pushed forward in its own special direction, and in—what is just as important—its relation to all other branches of science. Science stands or falls as a whole; if we limit it to certain purposes or persons it ceases to be science, and becomes mere empiricism. This association stands as a protest against the short-sighted and utilitarian policy of those who would cultivate only what they characteristically call the bread-and-butter sciences. Our purpose is the advancement of all the sciences, believing, as we do, that the true advance of one is inseparably connected with that of all the others, and by the advance we do not simply mean the increase in knowledge of its laws, but also in the application of it to the wants of mankind. Too often in the past the advance of science has been checked for generations by those who said they knew that the earth stood still, and who did their best to make it do so, and our protest is against the views of men of the same stamp in the present day, who think they know everything and select what is useful. Is that dreamy astronomer to be banished because he sits in some darkened dome peering through his telescope at some distant star, and wanting to know where it is. What has that got to do with the material advancement of the people? says the Utilitarian. Nay, that very quest, turned into a demand for better mechanical contrivances, better glass, and better workmen, led Fraunhofer to strain every nerve to meet it. He examined light in its passage through lenses most minutely, and thus learnt how to correct the previous errors in his telescopes, and while he did that he found those definite lines in the spectrum that will for ever be known by his name. He recognised their exact coincidence with those given by well-known terrestrial substances, and so gave the world the spectroscope, that most wonderful instrument working out through the most abstract science, the quickest, most perfect—ay, even the cheapest way of answering a thousand pressing questions in the money-making arts. Has chemistry served its purpose when it analyses our soils and our minerals, when it makes a mixture to take gold from quartz and money out of every slag? Is it not to go into our schools, and colleges, and universities, and teach those who will never use its solvents those wonderful affinities in nature, those laws of combination and dissolution, of solution and crystallisation, the laws which formed the water, built up the solid rock, the earth, the flowers? Is the study of pure mathematics to be banished because it cannot find an equation for the locality of a big nugget, when it has found and is finding thousands of equations which are mines of untold wealth in the material advancement of humanity? No, certainly not; for it is fitting that man, dwelling in that infinitely complicated organism his body, which responds on its ten thousand strings to every breath of nature, should study not one or two, but all the laws which govern it for weal or woe, and learn to place himself in harmony with all.

CORRESPONDENCE.

The Editor does not hold himself responsible for opinions expressed by his correspondents, nor can he take notice of anonymous communications. All letters must be accompanied by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

TOTEM CLANS AND STAR WORSHIP.

I read with much interest the paper of Mr. George St. Clair on the origin of Totemism, which you published in Nos. 15 and 16. It contains many views new and ingenious, and is full of interesting facts. I think, however, that the author has been led to exaggerate the part astronomy can have played in the formation of Totem clans. This desire to explain everything by astronomy is natural to the school of which Dupuis was the most brilliant representative, and was excusable when a high astronomical knowledge was attributed to the ancients. As I have already noticed somewhere else, the study of the Babylonian documents shows that real astronomy was unknown before the Greeks. The Babylonians did not know even astrology, a science which was devised by the Greeks of Alexandria, and which required a certain knowledge of the course of the planets. The Babylonians only took omens, and in these the sun played but a little part. The group of stars which presided over one month was not that in which the sun was rising, but that which occupied the most prominent place in the sky during the month. Another error was to believe that the year was always divided into twelve months; the Egyptians and the Semites divided primitively the year into ten parts. A remembrance of this division was retained by the Romans.

Another point. Knowledge of the stars, even empirical like that of the Babylonians, requires a long period of observation. If such knowledge be possessed by any organised society, it must have been constituted for a long time. I conclude, therefore, that totemism is anterior to star worship, and certainly anterior to a knowledge of the star groups. I go further; stars have received names of animals, like bull, goat, etc., because of their being assimilated to a great flock. They were named from those animals men saw round themselves; and if they had, as is pretty certain, special reverence for certain animals, they naturally gave to the stars these names in preference.

As to animal worship (which might in certain cases have been the origin of the totem clan system), its origin has been very well demonstrated by Dr. Oberziner ("Il Culto del Sole") and Professor Sayce ("Introduction to the Study of Language"). It proceeded on one way from a kind of universal sentiment of sympathy for all that lives, and on the other it was accelerated by the phonetic resemblance of names and also by symbolism. Astronomy certainly played no part in it. I, however, entirely agree with the lecturer as to the fact that every worshipper of an animal-god considered this animal as his ancestor. This never had been stated so clearly before.

There are many other points I should like to touch, as, for instance, the origin of exogamy, but I must put an end to this letter.

G. Bertin.

RECENT INVENTIONS.

The following list has been compiled especially for the Scientific News *by Messrs.* W. P. Thompson *and* Boult, *Patent Agents, of 234, High Holborn, London, W.C.; Newcastle Chambers, Angel Row, Nottingham; Ducie Buildings, Bank Street, Manchester; and 6, Lord Street, Liverpool.*

Paper.—Mr. J. Jameson has patented a safety paper to afford means of protection against erasure. It is coated with a very fine spray of a dense solution of a highly-soluble colour, and is thus rendered very sensitive, and will readily show whether it has been tampered with by erasure or any other alteration.

Explosive.—Messrs. E. Kubin and A. Siersch, both of Vienna, Austria, have invented a new explosive which on ignition prevents danger of explosion of fire damp or other gases in mines. The mixture used for this purpose is sulphate or chloride of ammonia intimately mixed (in the proportion of from 20° to 50° of the entire compound) with dynamite blasting gelatine or other explosives. On the explosion of this compound it will be decomposed into gases which are non-inflammable.

Electric Motors.—Mr. W. H. Mordley has patented an electric motor. This invention has reference to improvements in the construction of alternate current electric motors and to their application in connection with secondary batteries or accumulators for charging the same. The main object is to so construct alternate current motors that they shall possess the power of starting from a state of rest the speed regulating properties attaching to synchronous action and a high efficiency; this has hitherto been very difficult to do.

Electric Measuring Instrument.—Messrs. R. E. B. Crompton and J. Swinburne, of Chelmsford, have invented an improved apparatus for measuring the electric current. A needle is magnetised, and is suspended within a coil as in an ordinary vertical detector, but the needle is balanced so as not to stand at right angles to the axis of the coil; so that in deflecting the current has to overcome the gravity of the needle (or a spring may be used for a like purpose), and the angle of deflection is recorded on the scale in the usual manner.

Impure Liquids.—Messrs. E. Hermite, E. J. Paterson, and C. F. Cooper have patented means for disinfecting impure liquids, such as sewage, by mixing with the liquid to be disinfected certain chlorides, and then passing the mixture in thin sheets between electrodes connected to the terminals of a dynamo electric machine, and thus causing an electrical current to traverse the liquid as it passes the electrodes. The effect of this is a partial decomposition of the chloride, which causes an oxidation of the impurities rendering them innocuous.

Syphon Bottle.—Mr. H. Goffe, of the firm of Goffe and Sons, Birmingham, Warwickshire, is the inventor of improvements in syphon-ærated water bottles for fire extinguishing. The inventor takes an ordinary syphon bottle, and near the lower end of the spout he drills a hole, so that when it is desired to use the bottle as a fire extinguisher, all that it is necessary to do is to place the finger over the open end of the spout, when the liquid, being under considerable pressure, issues from the hole in a jet according to the size of the same.

DEPTH OF LIQUIDS.—Mr. F. C. Clare has patented means for ascertaining the depth of liquid in vessels. This invention is specially suitable for lamp reservoirs to indicate whether it is partially filled or nearly empty. A float is provided having a hole through it for the passage of a spiral rod, which is pivotted at the top and bottom in discs so that it can rotate freely. The hole in the float is shaped so that the rod freely moves and revolves as the float rises or falls, and on the upper disc is a pointer attached to the rod, which, as the spindle revolves, indicates the height of the liquid.

INK.—Mr. W. Hackney has patented a writing ink. The object is to prevent the inconvenience caused in many climates by the ink drying in the bottle, on the pen, or otherwise. This is prevented in the case of inks in which water is the chief constituent by adding chloride of calcium in the solid state to the ink, and by employing paper impregnated with sulphate of sodium, which will form, by double decomposition with the chloride of calcium, a salt which is not objectionable. The employment of this paper for writing upon prevents the objectionable qualities engendered by the employment of the chloride in the ink.

FLEXIBLE FILMS.—Mr. J. E. Thornton has patented a photographic flexible film. It is prepared in the following manner:—A suitable material, such as glass, is procured upon which to prepare the film, and a transparent material known as "algin" is employed for the preparation. This substance is soluble in water, and possesses the peculiar property of becoming insoluble in water after treatment with dilute mineral acid. To prepare a film it is only necessary to dissolve sufficient in water to make a thick glutinous solution, which is then flowed out on a level surface and allowed to dry. The resulting film is afterwards rendered insoluble, and is then stripped off the glass for use.

FIRING NAVAL ORDNANCE.—Mr. P. J. Crampton has patented means for firing naval ordnance. The object is to provide means whereby the guns can be fired automatically when the vessel is on an even keel. A plate is employed which has its plane constantly parallel with the horizon. On this plate are electrical contacts connected in pairs, and above them hang arms with corresponding contacts. The electrical circuit is connected with electric wires for firing the guns. The points on the arms are kept in a plane parallel with the horizon when the ship is on an even keel, by means of stops, and it is only when the electrical circuit is complete that the guns can be fired.

BALLOONS.—Mr. H. Lane has patented a method of constructing spherical balloons and other forms of gas or air bags of shapes known as solids of revolution. A spindle is constructed with tapering extremities bearing at each point of its length a geometrical proportion to a corresponding point of the balloon to be constructed. The spindle is supported on anti-friction wheels. The substances of which the balloon is constructed are spread over the surface of the spindle, the latter being rotated as the material is added. The fabric is then detached from the spindle and held in reserve until it has made sufficient revolutions to complete the amount of fabric required; the two extremities of the fabric are then joined together.

ANNOUNCEMENTS.

CAMBRIDGE.—At Emmanuel College the next examination for open scholarships will commence on Tuesday, December 11th, 1888. There will be offered for competition five scholarships, one of £80, two of £60, and two of £50. The scholarships are tenable, in the first instance for two years, but the tenure may be prolonged and the value increased if the scholar makes satisfactory progress and distinguishes himself at the annual college examination. The scholarships will be awarded for proficiency in classics, or mathematics, or natural science, or any two of these branches of study. Candidates in natural science are required to show a competent knowledge of chemistry. Every candidate must be under nineteen years of age at the commencement of the examination. The successful candidates must enter Emmanuel College and commence residence at the latest in October, 1889. Every candidate is required to send his name, with a copy of register of birth and a certificate of good moral conduct from some M.A. of Oxford or Cambridge, to Mr. W. Chawner, M.A., Tutor of Emmanuel, before Friday, December 7th, to whom all inquiries for further details concerning the examination should be addressed.

At King's College the next examination for scholarships will commence on Tuesday, December 11th. Four Eton entrance scholarships, two open entrance scholarships of £80, two exhibitions of £50, and at least three exhibitions varying from £70 to £40 will be offered. The scholarships and exhibitions, except one exhibition for natural science, will be offered for proficiency in classics, mathematics, or history. The open scholarships and exhibitions are open to all persons under nineteen years of age, who have not yet commenced residence. Candidates must send their names to Mr. G. W. Prothero, M.A., Senior Tutor of the College, not later than December 3rd, of whom further details of the examination may be obtained on application.

The Special Board for Geology and Biology recommend that the sum of £80, from the Worts' Travelling Scholars' Fund, be granted to Mr. M. C. Potter, M.A., of Peterhouse, to enable him to make botanical researches and to collect specimens in Ceylon during the winter months of 1888-9, on the understanding that he report the result of his investigations on his return.

LONDON MATHEMATICAL SOCIETY.—The following gentlemen will be recommended, at the Society's annual meeting, Nov. 8th, for election on the Council for the ensuing session:—J. J. Walker, F.R.S., President; Sir J. Cockle, F.R.S., E. B. Elliott, M.A., and Professor Greenhill, F.R.S., Vice-Presidents; A. B. Kempe, F.R.S., Treasurer; Messrs. M. Jenkins, M.A., and R. Tucker, M.A., Hon. Secretaries; A. B. Basset, M.A., Dr. Glaisher, F.R.S., J. Hammond, M.A., Prof. H. Hart, M.A., Dr. F. Larmor, C. Lendesdorf, M.A., Captain P. A. Macmahon, R. A., S. Roberts, F.R.S., and Dr. Routh, F.R.S.

GREENOCK PHILOSOPHICAL SOCIETY.—From the programme of arrangements for the coming session, sent us by the Honorary Secretary, Mr. J. Slater, we find that the following lectures will be given:—"The Great Ice Age," by Sir R. S. Ball; "Buried Cities of Ancient Egypt," by Miss Amelia B. Edwards; "Earthquakes, Volcanoes, and Geysers," by Commander C. Reade, R.N.; "A Dredging Cruise in the Atlantic," by the Rev. W. S. Green; "Ceylon as seen by Myself," by Prof. R. Wallace; besides a number of lectures on literary subjects.

NEW PUBLICATIONS.—Messrs. Iliffe and Son are about to publish a work which should prove of considerable value. It will be entitled "The Indispensable Handbook to the Optical Lantern," being a complete encyclopædia on the subject of optical lanterns, slides, and accessory apparatus. A specially useful feature will be a *catalogue raisonné*, descriptive of all the different sets of slides now on sale. This will undoubtedly fill a considerably felt want, as intending purchasers have had hitherto no information beyond the mere titles of the sets by which to make their selections, and these in many cases inadequately describe the features of the slides.

NOTICES.

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SELECTED BOOKS.

Force and Energy, a Theory of Dynamics. By Grant Allen. London: Longmans, Green, and Co. Price 7s. 6d.

Steam and the Steam Engine (an Elementary Manual of). By Professor Jamieson, M.Inst. C.E., Glasgow Technical College. With numerous illustrations, and examination questions at the end of each Lecture. London: C. Griffin and Co. Price 3s. 6d.

DIARY FOR NEXT WEEK.

Monday, Nov. 5—Gresham College, Basinghall Street, at 6 p.m.—*Lecture on Geometry*, by the Dean of Exeter.
Society of Engineers, 9, Victoria Chambers, Westminster, at 7.30 p.m.—*The Practice of Foundry Work*, by Mr. H. Ross Hooper.

Tuesday, Nov. 6.—Society of Biblical Archæology, 9, Conduit Street, Hanover Square, at 8 p.m.—*Is* אַבְרֵךְ (*Abrĕk*) (*Genesis* xli. 43) *Egyptian? The Thematic Vowel in Egyptian*, by Prof. P. le Page Renouf. *On Cuneiform Despatches from Tûshratta, King of Mitanni, Burraburiyash the Son of Kuri-Galzu, and the King of Alashiya, to Amenophis III., King of Egypt, and on the Cuneiform Tablets from Tell-el-Amarna*, by Mr. E. A. Wallis Budge.
Gresham College, Basinghall Street, at 6 p.m.—*Lecture on Geometry*, by the Dean of Exeter.

Wednesday, Nov 7.—Gresham College, Basinghall Street, at 6 p.m.—*Lecture on Geometry*, by the Dean of Exeter.
Dundee Naturalists' Society.—*The Flora of New Zealand*, by Mr. Alexander Hutton.
Entomological Society, 11, Chandos Street, Cavendish Square, at 7 p.m.

Thursday, Nov. 8.—Gresham College, Basinghall Street, at 6 p.m.—*Lecture on Geometry*, by the Dean of Exeter.
Society of Telegraph Engineers and Electricians, 25, Great George Street, Westminster, at 8 p.m.—*On Ocean Temperatures in Relation to Submarine Cables*, by W. Lant Carpenter, B.A., B.Sc.
London Mathematical Society, at 8 p.m.—*On the Confluences and Bifurcations of certain Theories*, by the President. *On Cyclotomic Functions*, by Prof. Lloyd Tanner. *A Theory of Rational Symmetric Functions*, by Capt. P. A. Macmahon, R.A. *Raabe's Bernoullians*, by Mr. J. D. H. Dickson. *Certain Algebraic Results deduced from the Geometry of the Quadrangle and Tetrahedron*, by Dr. Wolstenholme. *The Factors and Summation of* $1^n + 2^n + \dots + n^n$, by Rev. J. J. Milne.

Friday, Nov. 9.—Greenock Philosophical Society—*The Buried Cities of Ancient Egypt*, by Miss Amelia B. Edwards.

METEOROLOGICAL RETURNS

for the ten weeks ending on Monday, Oct. 22nd, 1888. Specially prepared for SCIENTIFIC NEWS from official reports.

	Mean Temperature.						Rainfall.						Duration of Sunshine.					
Scotland, East	50·2 degs.,	being	1·8	degs.	below	average.	3·3 ins.,	being	4·0	ins.	below	average.	263 hrs.,	being	9	hrs.	below	average
England, N.E.	50·7 ,,	,,	2·8	,,	,,	,,	3·4 ,,	,,	3·1	,,	,,	,,	258 ,,	,,	9	,,	above	,,
England, East	52·0 ,,	,,	4·1	,,	,,	,,	3·9 ,,	,,	2·2	,,	,,	,,	320 ,,	,,	18	,,	,,	,,
Midlands ...	50·9 ,,	,,	4·3	,,	,,	,,	3·5 ,,	,,	3·5	,,	,,	,,	300 ,,	,,	10	,,	,,	,,
England, South	53·4 ,,	,,	3·3	,,	,,	,,	3·4 ,,	,,	3·2	,,	,,	,,	346 ,,	,,	38	,,	,,	,,
Scotland, West	50·9 ,,	,,	2·0	,,	,,	,,	4·5 ,,	,,	6·2	,,	,,	,,	276 ,,	,,	9	,,	,,	,,
England, N.W.	51·6 ,,	,,	3·3	,,	,,	,,	4·4 ,,	,,	4·3	,,	,,	,,	289 ,,	,,	11	,,	,,	,,
England, S.W.	51·9 ,,	,,	3·0	,,	,,	,,	5·5 ,,	,,	4·7	,,	,,	,,	370 ,,	,,	27	,,	,,	,,
Ireland, North	52·6 ,,	,,	2·1	,,	,,	,,	4·9 ,,	,,	3·2	,,	,,	,,	247 ,,	,,	5	,,	,,	,,
Ireland, South	52·8 ,,	,,	2·4	,,	,,	,,	4·2 ,,	,,	4·4	,,	,,	,,	318 ,,	,,	23	,,	,,	,,
The Kingdom...	51·7 ,,	,,	2·9	,,	,,	,,	4·1 ,,	,,	3·9	,,	,,	,,	299 ,,	,,	14	,,	,,	,,

Scientific News

FOR GENERAL READERS.

Vol. II. | NOVEMBER 9, 1888. | No. 19.

CONTENTS.

SCIENTIFIC TABLE TALK.

By W. Mattieu Williams, F.R.A.S., F.C.S.

We have all read of the mysterious proceedings of the working bees when the queen of the hive is removed; how they break up three of the cells of neuter babies, make a pendulous royal cell of cylindrical form and greater dimensions, then by supplying the infant neuter maggots with royal food, convert them into female or queen bees, one of which ultimately receives the homage of the whole swarm. In the ordinary course, where no outside interference has occurred, the female is similarly evolved by modification of board and lodging.

With all our science we can do nothing like this. We can only study and admire, without any hope of imitating.

Many have thus studied the mysterious proceeding, and lately a Swiss gentleman, A. von Planta (an old fellow-student in Dr. Anderson's laboratory at Edinburgh), has worked out the chemistry of the different varieties of the pap which is respectively supplied to the cells of baby maggots which are ultimately to develop into male drones, neuter workers, or royal females.

This juice or pap is in all three cases a whitish, sticky substance, which more than thirty years ago was described by Leuckart (*Deutsche Bienenzeilung*, 1854, 1855) as a product of the true stomach of the workers, which they vomit into the cells in the same way that honey is vomited from the honey stomach. Others regarded it as a product of the salivary glands of the bees. Schönfeld, in numerous recent papers, has shown that Leuckart's view is the correct one. Schönfeld obtained saliva from the salivary glands of the head and thorax, and found it to be very different from the pap deposited in the cells; also that this is similar, both chemically and microscopically, to the contents of the bee's true stomach. He described also the anatomical structure by which the ejection from the stomach is effected.

Von Planta's investigations of the chemical composition of the contents of the bee's stomach and of the juice supplied to the three classes of cells entirely confirm the conclusions of Leuckart and Schönfeld. Preliminary microscopical investigations afforded the following results, which were quite in accord with the results of subsequent chemical analyses :—

1. The food of the queen-bee larvæ is the same during the whole of the larval period; it is free from pollen grains, their substance having been reduced to a thickish but homogeneous juice by the digestive action of the worker-bee's stomach.

2. The food of the larval drones is also, for the first four days of the larval period, free from pollen. It appears to have been digested in like manner, but after four days it is rich in pollen grains, which have, however, undergone a certain amount of digestion.

The following table of average percentages of several of Von Planta's analyses is given in the *Journal of the Chemical Society*:—

	Food Stuff of		
	Queen Bees.	Drones.	Working Bees.
Water	69·38	72·75	71·63
Total solids	30·62	27·25	28·37
In the Solids—			
Nitrogenous material	45·14	43·79	51·21
Fat	13·55	8·32	6·84
Glucose	20·39	24·03	27·65
Ash	4·06	2·02	—

"All were of greyish colour; that of the queen bee was the stickiest, that of the workers the most fluid. Peptone appeared to be absent; the greater part of the nitrogenous material present was proteid. The ethereal extract was in all cases acid, but formic acid was absent." The sugar contained in pollen grains is invariably cane sugar, but in this food supplied to the larvæ it was found to be, in all cases, invert sugar, or glucose, the form of sugar which is formed in the bodies of animals—ourselves included—by the action of the salivary diastase upon the starch and cellulose of vegetable food.

Not only is there a difference in the composition of the food, but the quantity supplied varies very greatly.

The juice from 100 queen-bee cells yelded 3·6028 grammes of dry substance, that from 100 drones' cells 0·2612 gramme, from 100 workers' cells 0·0474 gramme.

Reviewing these results, some approach to a theory may be framed. We may, I think, venture to conclude that the fundamental character of the royal food which effects the development of the queen is that it is supplied in a partially digested condition, thus permitting the infant maggot to devote more of its vital energies to the business of assimilation and growth. The other maggots are supplied with food in this condition at first, but afterwards they have the pollen in semi-digested condition, and finally when fully grown they get it directly in its crude state from the plant.

This nearly corresponds to the proceedings of the mammalian vegetarians. The cow supplies the young calf with digested grass in the form of milk during the period of most rapid growth, and those who are behind the scenes at cart-horse shows know that the prize specimens are fed upon milk; they commonly have a couple of cows in attendance upon each. Bulk is thus attained, if nothing else.

The above table shows that the greatest difference between the food supplied to the queen and the other young bees is in the fat, the quantity of which is about twice as great as that provided for the ordinary worker maggots that are not to be developed into queens. This is curiously analogous to the difference between the milk of the herbivora and graminivora and the grass or grains of the food of the adult. Even in the carnivora, which obtain more fat in their ordinary food, there is still an excess in the milk. Thus, according to Dr. Miller's analyses, cow's milk contains an average of 4 per cent., goat's 4½, sheep's 4½, while the milk of the bitch contains 14·8, about 3½ times as much. The milk of the porpoise contains 45·8 per cent. of fat.

Analogy justifies us in supposing that the fatty matter supplied to the cells is obtained by the adult bees from starch, glucose, or other vegetable sugar; and here it is that the greatest change occurs in the course of digestion of vegetable food; the conversion of carbo-hydrates into hydro-carbons, the splitting or dissociation of the water of the carbo-hydrate, the disposal of the oxygen, and leaving the carbon with the hydrogen only. Much work is demanded for effecting this change, and a corresponding exhaustion of energy is saved for the work of larval growth.

These microscopic and chemical investigations, however interesting in themselves, contribute nothing towards a solution of the mystery of the balancing of the sexes which occurs spontaneously in most species, notably so in man. If variations of food had any influence here, it would surely show itself now that we have so many sectarians in the matter of food; some that abjure alcohol, others abstaining from flesh food; some denouncing tea, coffee, tobacco, etc., and even cases of total abstinence from all liquids; men and women who use neither cups nor glasses, nor even the oyster-shell of Diogenes, but depend upon fruit and green food for all the liquid they require. Then we have whole tribes, like the coast Lapps, that feed only on fish; others, like the Fjeld Lapp, who depend almost exclusively on the reindeer, gathering only a few pot-herbs in the summer; others feeding on raw flesh, on roots, etc., etc.

In none of these have we any special preponderance of either male or female infants when any considerable number of families is counted. Neither climate nor seasons, nor sedentary or active habits, have any visible effect.

It is true that certain families consist mostly of boys, others of girls; but, somehow, they balance each other in the mass, just as the proportion of mere accidents remains the same when we take large averages; like the constant percentage of undirected letters containing valuables that are annually deposited in the boxes of the Post Office, or the number of people annually killed in the streets of London.

We have no record of any race, of any place or period, that has been specially distinguished by its preponderating production of either male or female infants.

THE LATE ERUPTION OF VULCANO.

THIS formed the subject of a paper in the Geological Section of the British Association, at the late meeting at Bath, by Dr. Johnston-Lavis and Dr. Tempest Anderson. It was illustrated by photographs thrown on the screen by a lantern, some of which we now reproduce. They were taken by Dr. Anderson in May of this year, and consequently represent the island as it was before the eruption.

Identified in the older mythologies with the forge of Vulcan and the workshop of the Cyclops, where, according to Virgil, the armour of Æneas was forged, this island has always been an object of awe and superstitious dread to the dwellers in the two Sicilies.

In later times, when fear and fancy had begun to give way to curiosity, the historians, geographers, and philosophers of Rome gave more sober and accurate accounts of its phenomena; and its later name of Vulcano, or Volcano, has gradually come to be applied to all mountains of similar character. Numerous eruptions are recorded from it, by Thucydides, Aristotle, and in the second century before Christ by Diodorus. It is probable that the small island of Vulcanello, now connected with Vulcano by later eruptions, was formed at this period.

In the middle ages it was regarded as the place of torture of Theodoric, an Arian emperor.

From the end of the fifteenth century a long series of eruptions are recorded, which have frequently driven away the inhabitants and devastated the island.

Vulcano is an island about five or six miles in greatest length, and is situated to the south-west of Lipari, from which it is separated by a narrow strait. The southern part of the island consists of several semi-circular crater rings, which have been formed at successive periods, as the point of eruption has shifted along the line of the great fissure which, no doubt, underlies the island. Towards the north-west end is the large active cone and crater, surrounded by a deep valley (Atrio) which separates it from the old crater rings.

Its summit is truncated, and shows vestiges of several craters, which have been successively formed and destroyed. One of these, the Forgio Vecchio, is well-shown in the centre of fig. 2. Above the Forgio Vecchio is the great fumarole referred to in Mr. Narlian's letter. In the irregular summit of the mountain are many fumaroles, and towards the south part is the large crater the bottom of which is shown in fig. 3. Its floor contains many large and active fumaroles, from which vapours constantly escape, with often much noise. These vapours consist of steam containing boric acid, arsenic, and other substances. Some years ago chambers for condensing these vapours were erected on the floor of the crater at a cost of several thousand pounds, and a road, shown in fig. 4, was constructed, leading down to them, but a slight eruption of the mountain destroyed them utterly in one day. In May, 1888, no attempt was being made to utilise these vapours, but sulphur was still extracted from above the Forgio Vecchio. The workmen live in caves excavated in the Faraglione,

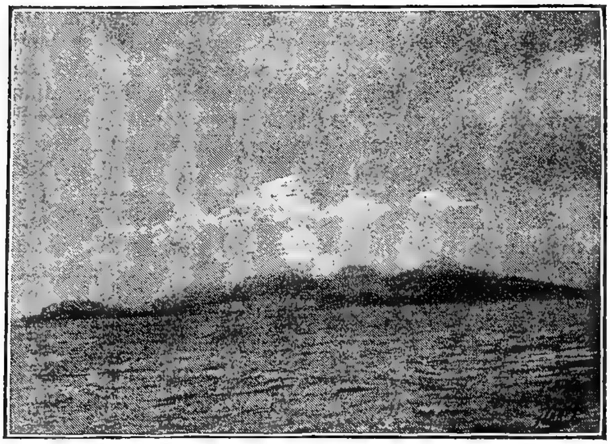

FIG. 1.—VULCANO FROM THE NORTH-WEST.

the detached mass of rock shown in fig. 2, just behind the white villa of Mr. Narlian. Some of these caves are of great antiquity, and were the source from which the ancient Romans obtained much of their alum. Though affording, according to our notions, only very limited accommodation, they are preferred by the natives to houses, as being warmer in winter and cooler in summer,

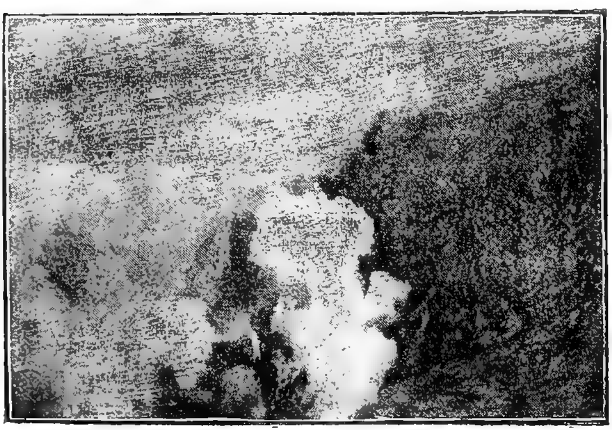

FIG. 3.—VULCANO. THE CRATER.

and also, it appears, as being safer abodes than those of their more pretentious neighbours'. The dark lava-stream shown in fig. 2, to the right of the picture, consists of obsidian, and was probably erupted in 1775. It is remarkable for its steep slope, and the manner in which the materials forming its lower part have been piled up on reaching more level ground, thus showing the extremely imperfect state of fluidity in which it was poured forth.

The following letter of Mr. Narlian, whose villa is shown in fig. 2, gives a most graphic account of the recent eruption :—

"Lipari, Aug. 30th, 1888.

"My dear Dr. Johnston-Lavis,—I have your kind note of the 22nd inst., and will give you a short account of the strange doings of our old friend the crater of Vulcanus.

"On the 3rd inst. we had an outburst in the crater, with stones, flames, thunder (regular lightnings). It was strong enough to throw stones of considerable size to the sides of

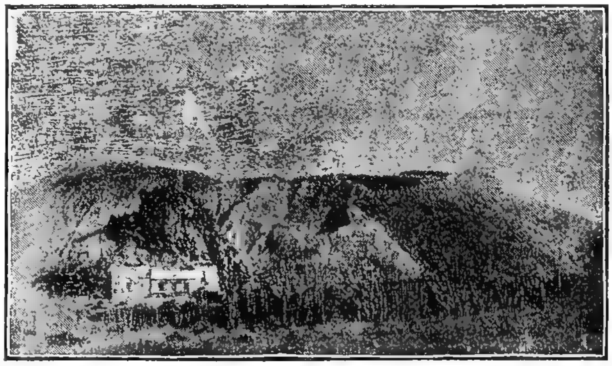

FIG. 2.—VULCANO. MR. NARLIAN'S HOUSE IN THE FOREGROUND; THE FARAGLIONE BEHIND IT; THE FORGIO VECCHIO AND OBSIDIAN LAVA CURRENT ON THE SLOPES.

the mountain. This lasted perhaps 10-15 minutes, and then ended. After some time we began to have, at the interval of every 20-30 minutes, a great rush of thick smoke, lasting some 10-12 minutes at a time. We had often seen such eruptions during 12-13 years I have been on the island, and I hoped it would end like former eruptions. Towards evening, however, these rushes of smoke, steam, and ashes (which

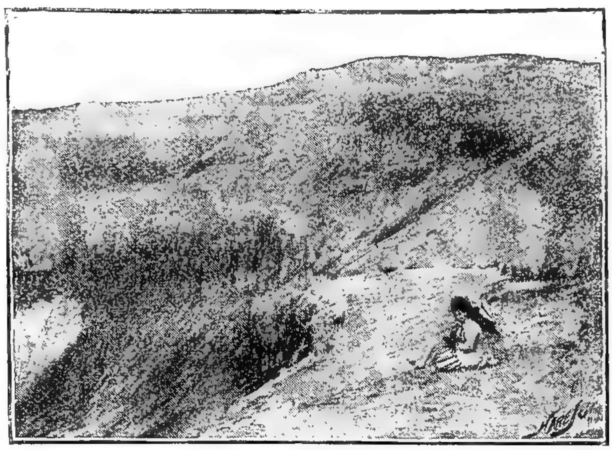

FIG. 4.—VULCANO. THE ROAD INTO THE CRATER.

used to be projected into the air to about twice the height of the mountain) had completely ceased. As the night approached, the leading fumarole (which was very active, giving off an offensive smell for months before the event) had begun to show a clear high flame, much paler than the flames produced by the burning of wood, and somewhat greenish or bluish. This phenomenon, together with the sudden stopping of the smoke, was not evidently a good omen. Consequently, I spent all the night dressed on a sofa in the drawing-room. Towards morning I was overpowered by sleep, and went to the little bed-room which looks towards the mountain, rested on the bed, and soon was evidently sound asleep. Soon afterwards I was awakened by a tremendous din, which can hardly be described. As I jumped up from my bed I felt stones falling on the roof as hail—such cannonading going on. I understood what was the matter, ran to the opposite room, where I had made my children sleep that night. They were also up, in consequence of indescribable noise of thunder, rush of gases, flames, falling of huge boulders, rocks, etc. I took them to the drawing-room, but as soon as the door was opened a big stone, red hot (all these stones were quite red with heat) fell through the roof, ceiling, and floor a few yards from us, smashing all, setting fire to everything. Now I took my children back to the bed-room, which looks on to the verandah, and tried to gain the terrace by that side. The house doors were shivering and shaking, so that it was a difficult matter to open the doors. At last I succeeded, but before we were out in the verandah another stone fell at our feet, was smashed to fragments, and burned the feet and legs of my boys. Now we passed through the verandah, regained the house at the top of the stairs; here another stone fell very near us (none of these stones were less than 2 ft. in diameter). This last stone (which is the fourth that struck the house, including the one that fell on the ceiling of my bed-room while in bed) had nearly blocked our way out in the rubbish that it brought from the roof. We passed through over the heap of rubbish, and were now out in the open to the north of the house. By this time (not many minutes after all) the whole place was lighted up, woods, grass, buildings, hedges—all was on fire; the huge boulders and stones were literally raining everywhere about us—what confusion! Natali, the faithful boy, had by this time come to the help of my little boys. We all began to run to Vulcanello and away from the dreadful thundering mountain. All the means of communication we possessed at Vulcano consisted in an old half-broken 20-ft. boat and a lighter, both of which the men in their panic and mad despair had taken away with them, leaving us on the sands of Vulcanello. Towards noon, however, boats of rescue reached us from Lipari, and we thus ended one of the most eventful days of our life.

"On revisiting the spot I saw the whole plains below the mountain, to the distance of one and a-half miles, especially the neighbourhood of the house and the men's habitations, literally covered with boulders and rocks of all sizes, which have embedded themselves in the ground to various depths. The most huge of them is near the well of the house, and is not less than 10 yds. in diameter, or better in length, and is some 10-11 ft. deep in the ground. This is about three-quarters of a mile from the crater. Another, of nearly equal dimensions is on the shore near the Quarantana at the end of the bay of the Levante. Rocks of one yard in diameter are as plentiful as can be as far as the middle of Vulcanello, near the Punta Samossa. We have to thank God for going unhurt through this 'hail-storm.'

"After this awful calamity, which has caused me so much loss, the crater has recommenced the rushes of steam, ashes, etc. This was a time of comparative diminution of activity, which has lasted for some days. Soon, however, it began the old game of throwing stones, boulders, ashes, etc., every two or three minutes in all directions. No doubt many of these boulders are 10-15 yds. across, and are projected as far as the sea, but often fall back in the crater itself. This state is continuing incessantly and uninterruptedly, causing further damage and frightening everybody.

"During the last three or four days the noise of the thunder and eruption is so loud that from Lipari (at the distance of six miles) it would be impossible to distinguish it from a prolonged thunderstorm.—Yours truly,

"A. E. Narlian."

Intercolonial Meteorological Conference.—An Intercolonial Meteorological Conference met in September at Melbourne. Mr. Ellery was elected Chairman. The other members present were Sir James Hector, Mr. C. Todd, Mr. H. C. Russell, Mr. C. L. Wragge, and Commander Shortt.

THE WHOMBEYAN CAVES.

Mr. W. S. Leigh, of the Geological Survey Branch of the Australian Department of Mines, has given the following account of the new cave recently discovered by Mr. M. Chalker at the Whombeyan Caves, near Goulburn, New South Wales.

"The entrance, a round opening about 2 ft. in diameter (which it is proposed to enlarge) is situated on the face of a rather steep hill, and is about 200 yards north-west of the mouth of the old cave, and 500 yards from proposed site of the cave-house. After passing through the entrance into the new cave a perpendicular descent of 25 ft. is made, and then a further descent for a like distance on an incline, the passage progressively increasing in size the lower you descend, until the bottom is reached, where it opens out into a large chamber about 50 ft. by 30 ft., and averaging 10 ft. in height. This chamber contains a fine collection of stalactites and columns, etc., and may be termed the 'Hall,' as the main caves radiate from it in three different directions.

"The first branch to the right of the entrance runs about due north about 100 yards in a zigzag line on a comparatively level floor, and averages about 10 ft. in width and 12 ft. in height. The floor for 20 or 30 ft. from the entrance is remarkably pretty in its formation, resembling a stream of crystals overflowing from a large basin, the stream below the main basin being composed of innumerable miniature basins in terraces, each basin being filled with a pure white coral-like formation. Other parts of the floor are covered with spherical stalagmites resembling snowballs. The stalactites in this, as also in the other branches, are grouped more regularly than is usually the case, as they run in almost parallel lines across the limestone roof. These, as well as the other formations, are remarkable for their snowy whiteness and transparency, the only exception being an occasional nest of stalactites resembling terra-cotta in appearance, and so lending a pleasing variety of colour. A very singular feature here is a large column of stalactites having small stalactites varying in size from the thickness of a needle to half-an-inch in diameter projecting at all angles round its base, the whole resembling very much the trunk of a tree with the young shoots sprouting up all round.

"The middle branch cave, by far the largest, consists of a chain of chambers ranging from the size of a small cabin to that of a lofty cathedral. These are formed by the immense rocks falling and wedging themselves together in all shapes, which necessitates the making of a number of steep ascents and descents. The chambers are well filled with all the prettiest formations met with in other caves. An instance is also observable of a large column formed of a number of stalactites, having been naturally broken across at a point about half way between the floor and the roof, the broken surfaces being separated from one another by a space of about 2 ins., so that the upper part of the column remains suspended from the roof.

"A further extension of this cave was discovered during my inspection, and I may safely say it is the crowning discovery as yet in the whole cave, being a roomy chamber at the extreme end (as far as yet known) of this branch, the floor of which might appropriately be named the 'crystal lakes,' the so-called lakes being a large number of pure white and transparent basins formed into a succession of terraces, each basin being partly filled with minute crystals having the exact appearance of water, the illusion only being discovered by touch. To see this formation alone would well repay the visitor for the trouble experienced in reaching it.

"The third branch, to the left of the last described, is comparatively small, and consists of a narrow winding passage, at the end of which is an almost circular chamber, being the main part of the branch. It contains a good collection of stalactites and stalagmites, and also some fine coral-like beds, the floor being of a crystallised dripstone. Fossilised bone deposits are found in some parts of the cave, a few specimens of which I brought down for examination. The roots of the Kurrajong tree, growing 50 ft. overhead, appear through the roof of the cave, and seem to take root again below the floor, some of them having a thick coating of lime. This cave in some respects resembles very much the Imperial and Lucas caves of Jenolan—the former in the fineness, transparency, and delicacy of its stalactitic structures; and the latter in some of its spacious and lofty chambers; and I may safely add that some of its formations, a proper description of which it would be difficult to give, if seen by the aid of the magnesium wire or other such light, would be proved to be quite equal to some of the best found at the far-famed Jenolan Caves. I may add that this discovery cannot be over-estimated, and it adds immensely to the interest of the Whombeyan Caves for those desirous of studying the wonderful and beautiful phenomena of the ancient subterraneous river channels hollowed out of the massive marble and limestone.

"In conclusion, I may state that as time and circumstances permit, further explorations will be carried out, it being my firm belief that other large chambers exist connected with this cave."

ROMAN REMAINS AT LLANTWIT-MAJOR.

LLANTWIT-MAJOR, or more correctly, from a Welsh point of view, Caerworgan or Caerwrgan, is a quaint little agricultural town in Glamorganshire. It consists almost entirely of queer-looking cottages, arranged in a most curious and irregular manner in the crooked streets, with nice little gardens back and front. Llantwit contains many ancient fragments pleasing to the antiquary. It is accessible from the Cowbridge station on the Great Western Railway, and is also an agreeable drive of about eighteen miles from Cardiff.

Situated a mile to the northward of Llantwit is a field, which, on entering, does not strike the visitor by exhibiting anything extraordinary or different from any ordinary pasture or meadow; but on rounding a haystack, peculiar inequalities of the surface attract attention, and a line of large pieces of rock, resembling stones for building, indicate that something is going on, and on wending our way in that direction, we observed a trench extending some distance, large heaps of earth, stones, and sundries showing us at once that some extensive excavating operations were going on, and from a tent in the field were evidently still in progress. Looking around, we could not help thinking, whatever could have induced any one to come to this out-of-the-way spot, and when there, what was it made them think of digging for Roman remains; and as our readers will most likely be as inquisitive as we were on this point, the history and *modus operandi* of these excavations will, doubtless, be as acceptable to them as they were to us.

Mr. Storrie, the astute and able curator of the Cardiff Museum, is an ardent naturalist, and makes frequent rambles in remote parts in search of things and specimens of scientific or general interest. One of these excursions, in quest of botanical specimens, led him to the field in question. He was attracted by the peculiar hillocks and irregular ridges, and expressed an opinion, that archæological remains of considerable importance were hidden under the surface; and as his opinion, in such matters, is regarded as second to none in the district, at his request the Cardiff Naturalists' Society took the matter in hand, and having procured the necessary funds, decided to make excavations in the field.

A preliminary probing of the field seemed to indicate that walls existed under some of the ridges, and when sufficient evidence was obtained by this means steps were taken to commence operations in a systematic manner. As a first step it was decided that a trench should be cut straight across the ridges, in a direction which appeared to intersect the greatest number of buried walls or ridges, or whatever they were.

The work of digging a trench about 5 feet wide and 2 feet deep was started in August of this year, from the

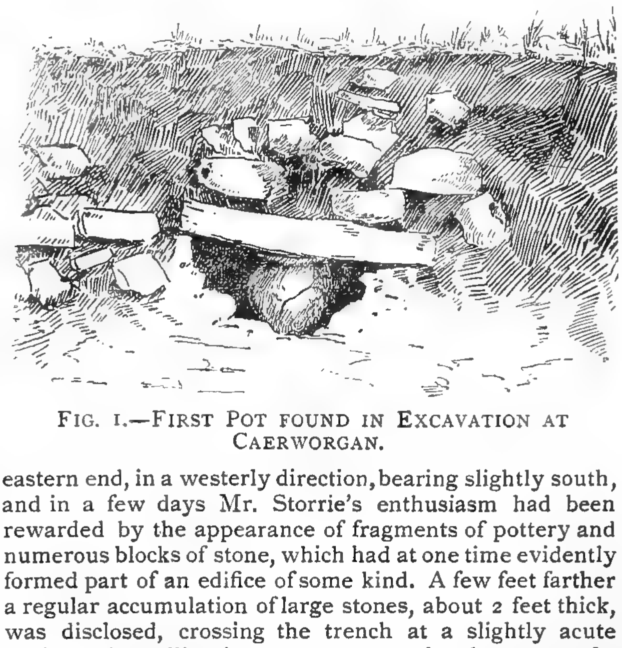

FIG. 1.—FIRST POT FOUND IN EXCAVATION AT CAERWORGAN.

eastern end, in a westerly direction, bearing slightly south, and in a few days Mr. Storrie's enthusiasm had been rewarded by the appearance of fragments of pottery and numerous blocks of stone, which had at one time evidently formed part of an edifice of some kind. A few feet farther a regular accumulation of large stones, about 2 feet thick, was disclosed, crossing the trench at a slightly acute angle, and recalling in many respects the characters of a dry stone wall. Within about 30 feet from this, a perfectly well-defined dry stone wall was encountered more than 3 feet thick, and running parallel to the other wall. About 20 feet from this wall an interment was observed under a large flat stone. On removal, it was found to consist of an urn of black pottery (now in the Cardiff Museum), containing charred remains, along with extraneous matter from the surrounding soil, such as earth, worm casts etc. From our illustration (fig. 1.) it will be noticed that the urn was evidently interred with much care. It would seem, therefore, to have contained remains of some importance, and Mr. Storrie expresses an opinion that a tumulus formerly stood where the urn was found. In close proximity to this, another wall was soon exposed to view, running parallel with the others, but of much greater solidity, being nearly 4 feet thick, and built of stones and mortar. Fragments of pottery, including some Samian (?) ware, were frequently dug up, and among the *débris* a piece of a bronze fibula. Another 70 feet brought the trench to another wall of stone and mortar, only 2 feet thick, and not running right across the trench; further investigation brought an angle of this wall to light, and it was almost certain that some enclosed space had now been entered. The excavations from this point teemed with interest. The trench passed over the wall forming the angle, as noted above (being evidently the wall of an enclosed space), exposing 27 feet of it, when another wall at right angles to it was met with, and thus introduced a second enclosed space. In the first enclosed space part of a quern, or hand-mill, was dug up, whilst the small corner of the second enclosed space, included in the area cut by the trench, proved to have plastered and decorated walls as well as a tesselated floor; moreover, human remains were exhumed here.

(To be continued.)

SUBMARINE EARTHQUAKES AND ERUPTIONS.

FREQUENTLY and closely, as it is remarked in the *Naturforscher*, as the quakings of the dry land have been investigated concerning the manner of their occurrence, their extension, and their causes, exceedingly little is known concerning the quakes of the sub-oceanic portion of the earth's crust. Nothing has been ascertained and recorded beyond the bare fact of their existence. At most we may say that the so-called earthquake tidal waves, such as those of Simoda (1854), Arica (1868), and Iquique (1877), have given occasion to researches. But the object in view was not so much to ascertain the causes of the phenomena as to draw from the movement of the waves conclusions as to the depth of the ocean. Recognising this deficiency in our knowledge of the seismic action of the earth's crust, Herr E. Rudolph, of Strassburg, has undertaken to collect all accessible records of seaquakes in a catalogue which extends to eighty pages. He characterises and classifies the seaquakes in accordance with the variable manner of their occurrence and their mechanical action, and explains the processes on the basis of the physical laws of wave-motion in solids and liquids.

This author gives the name of seaquakes to all agitations which have their origin in the bottom of the sea, and which, passing over to the mass of the ocean, are propagated as waves of elasticity. They are manifested to the observer by the shock which the ship undergoes, by a noise, and by phenomena on the surface of the sea.

A seaquake is felt by the sailors as if the ship had run aground, and was passing over it rapidly. According to the intensity of the shock, it may be merely a gentle but strange trembling in the ship, but in stronger shocks heavy objects are overturned, men are flung upwards, and ships even dismasted. In extreme cases the vessel itself may be lifted or thrown on its side, though its direction and speed are unaffected. As to the nature of the shock, both undulatory and succussory movements can be felt.

The atmosphere is not affected in seaquakes, save that there occur phenomena of sound which seem to have their origin in the sea, and which have been compared to a rumbling, or to distant thunder.

According to the action of seaquakes upon the water they are divided into two great classes. In the majority of cases the submarine shock passes over without exerting the least influence upon the mass of water. A change in the condition of the sea is not produced by the most intense shock in perfectly calm weather. This holds good alike in deep and shallow water, even along coasts. In some cases an ebullition was observed, and peculiar jets of water, like those produced by the impact and rebound of violent rain, were thrown up to the height of about fifteen inches.

From such seaquakes Herr Rudolph distinguishes those which raise up the water in mighty waves in all directions. At the same time the sea throws up abundance of bubbles, a roaring sound is heard in the depth, vapours are given off, and the water becomes distinctly hot.

As to the duration of these seismic movements under the sea, the extent and the limits of the region shaken, and the speed of the propagation of the shock, little can be said, as, for the most part, each seaquake is recorded by one ship only. Often many shocks succeed each other at brief intervals, but the duration of each shock is for the most part very short, and prolonged agitations are rare. An extensive region has been observed to be shaken in four cases only. The rate of propagation on the surface from the epicentrum was found to be 594 metres in a great seaquake in the Bay of Bengal.

The author attempts to explain the phenomena observed by a comparison with those produced in submarine blasting operations undertaken to remove a sunken rock in the harbour of San Francisco, and reported by the younger Le Conte in 1874. In this manner he very successfully refers the ordinary seaquakes, in which the surface of the sea is not disturbed, to submarine shocks. Those cases when huge waves are raised which dash upon the coasts in the manner of an exaggerated flood-tide are the result of volcanic outbreaks beneath the sea.

Seaquakes have been experienced in all seas, deep or shallow, and in their distribution they do not depend on the plasticity of the bottom. There are, however, certain regions in which they are exceptionally frequent, as in the Atlantic, in the seismic zone of St. Paul's Rocks and on their eastern side, near the Azores and the Lesser Antilles, near the Sunda Islands in the Indian Ocean, and along the greater part of the coasts of the Pacific. The "earthquake flood-waves" are almost peculiar to the Pacific coasts.

Rudolph forms the conclusion that the frequency and intensity of the manifestation of seismic and volcanic forces at the bottom of the sea is not connected with the distance from active or extinct volcanoes on the dry land.

If we except the few regions which are quite free from seaquakes, the bed of the ocean is, as compared with the land, a region of intensified seismic and volcanic activity.

Lastly, the author inquires into the causes of seaquakes. In four cases he shows a probable connection of seaquakes with dislocatory fractures, and two of these cases were accompanied by submarine eruptions. The numerous seaquakes of littoral zones he refers also to similar fractures. The desultory seaquakes occurring in all oceans, and especially in the deeper regions, are considered to be shocks produced by the injection of molten matter into the plastic substance of the deeper parts of the earth's crust.

General Notes.

New Minor Planet.—Dr. Palisa, of Vienna, discovered another minor planet (No. 280) at 1 30 a.m. on Nov. 1st. The position then was, right ascension 2 h. 2 min. 46 sec. (decreasing 1 min. 8 sec. daily); north Polar distance, 76 deg. 25 min. 31 sec. (increasing 1 min. daily). It is of the 12th magnitude.

The Microbia of Yellow Fever.—Dr. G. Sternberg (*Therapeutic Gazette*) argues that the microbia of yellow fever, unlike the bulk of disease-germs, flourish in an acid medium and that alkaline medicines are most likely to prove effectual in its treatment. It is right to add that this system has worked successfully in practice.

Glass Blowers' Cramp.—M. Poncet (*Popular Science Monthly*) describes a peculiar deformity of the hand occurring among glass-blowers, and known as glass-blowers' cramp. It consists in a permanent and decided flexion of the fingers, especially of the third and fourth finger of the hand, which comes on after a short practice in glass-blowing and increases progressively.

The Position of Timbuctoo.—M. Caron, the French officer who recently sailed down the Niger to Timbuctoo, took two observations near the city, which materially alter the position assigned to it by Barth, and laid down on many maps. He deduces from these observations that the latitude of the city is 16 deg. 49 min. N. and longitude 5 deg. 12 min. W. from Paris. Barth gave the former as 18 deg. 3 min. 45 sec., and the latter 4 deg. 5 min. 10 secs.

New Comet.—Mr. Barnard, of the Lick Observatory, announces the discovery of the sixth comet of the present year at 1 p.m. Greenwich time on October 31st. The comet at that time was in Right Ascension 9h. 43m. 22s. (increasing $1\frac{1}{2}$ min. daily), and North Polar Distance $105^\circ\ 18'\ 52''$ (decreasing $9'$ daily). The physical appearance is described as "11th magnitude, $1'$ in diameter, slightly elongated, strong central condensation." This is the second comet discovered by Mr. Barnard at the Lick Observatory.

Royal Geographical Society.—The two first meetings this season of the Royal Geographical Society will be of unusual interest. At the first meeting, on November 12th, Mr. H. H. Johnston, Her Majesty's Consul on the West Coast of Africa, will describe some of the results of his recent visits to the Cameroons and the oil rivers. At the second meeting, November 26th, Mr. Joseph Thomson will give an account of his recent visit to Morocco. A few days later he will leave for East Africa, probably to be absent for some considerable time.

Singing Sands.—Dr. A. Julien and Professor H. C. Bolton (*Science*) have communicated to the New York Academy of Sciences the results of their examination of sonorous sands. Such sands are always clean and free from dust, consisting of angular or rounded granules, between one-third and one-half of a millimetre in diameter. The chemical composition is not important. When such sands are moistened by rain or by the tide, and the moisture is afterwards evaporated, a film of condensed air is formed on the surface of each grain which acts as an elastic cushion, and enables the sand to vibrate when disturbed. Such sands can be rendered mute by heating, rubbing, or shaking.

Wood Creosote.—Captain W. H. Bixby, in the United States Forestry Department's Report, greatly recommends crude creosote for its antiseptic properties. It is an efficient poison for both animal and vegetable life, and its tarry acids possess the property of coagulating albumen and other fermentible matters. It forms an excellent insecticide, and is one of the best possible oils for preserving timber and piles. If painted upon wood or metal, it preserves from wet and dry-rot, rust, and the attacks of insects. If forced into wood by hydraulic pressure, it fills all the pores, and extends its coagulating and antiseptic effects to the very centre of the block.

The Prehistoric Race in Spain.—MM. H. and J. Siret (*Science*) have published the results of their archæological researches in South-Eastern Spain, and have traced the history of the early races inhabiting that country. The most ancient remains seem to belong to the neolithic age, the use of copper and bronze coming in subsequently. They fully confirm the recent view that in most parts of Europe the bronze age was preceded by a copper age. At the close of the bronze age, the use of silver is introduced and fortified villages occur. The principal result is that various races occur among the early inhabitants. A series of dolichocephalic skulls has been found, with an average cranial index of 73·8 and a long face. The nose is long and the orbit high. This is the exact counterpart of the northern inhabitants of Europe. Besides these, Jaques found a short-headed race also with long faces, high noses and orbits. This type also occurs in Northern Europe. A third race is also brachycephalic, but with a broad, flat face and prominent jaws.

The White Sea.—The hydrographers charged with an exhaustive inquiry into the depth and navigability in other respects of the White Sea, recently returned to Archangel. They began their investigations at the end of May in the Bay of Onega. One party of three officers made a special examination of the Gulf of Soroki. One discovery was that of a bank 11 ft. below water-line, where a depth of 35 ft. was marked on the chart. As there is a project mooted for a canal from Onega to the White Sea, it is observed by the explorers that a good port at Soroki is essential. Several deviations were also noted in the channels of the rivers Corelia and Dwina. The former will soon be dried up, while the latter promises to improve. A lighthouse is pronounced necessary on the island of Kü, and another is scarcely less needed at Cape Zetny Orlow. The reefs off Moutssalma island are also badly indicated, and the lighthouse at Orlow would be useful as indicating their precise situation. In support of these improvements the fact is put forward that Russian ships are wrecked by hundreds in the Arctic seas.

Cocoanut Fibre as a Defensive War Material.—In the last report of the curator of the Nilgiri gardens, attention is drawn to a new use for the refuse fibre of cocoa nuts. Dr. Lawson says that his attention was drawn to the subject by Mr. Money, a planter in the Nilgiris, who sent him an article in the *Revue des Deux*

Mondes for August 1st, 1886, by M. de la Barrière, entitled, "Bâtiment de combat et de la guerre," in which the author described how the refuse of cocoa nut, after the process of retting, might be used for backing the iron plates of ships of war. The method of proceeding was to take a quantity of the powdered refuse before it was quite dry, and subject it to pressure, when the natural viscidity of the macerated cellular substance of the nut caused the whole to cohere and to form a plate which in general appearance was like a mill board, only much more brittle. Owing to the hygroscopicity of this substance, if a hole be made through it, the parts adjacent to the puncture absorb water, swell up, and immediately close the orifice. Dr. Lawson got a sack of this refuse and made a plate 18in. square, by about ¾in. in thickness, which he placed between two boards, and then fastened it to one side of a box, which contained a head of one foot of water. A bullet half an inch in diameter was fired through it, but not a drop oozed out. This experiment was repeated three times with the same result. Then a ¾in. bullet was fired through the plate, when a few drops only made their way through. Lastly, a bullet nearly 1in. in diameter was fired through the plate, when a large jet of water shot through, but in the course of a few seconds the stream decreased in volume, and in less than a minute had ceased to flow altogether. "Whether or not this material could be advantageously used for the purpose which M. de la Barrière suggested, or for any other purpose, is a matter worth considering, for, as he truly says in his article, millions of tons float away annually down the rivers in India."

Men of the Stone Age in Central Brazil.—Dr. Karl von den Steinen, the explorer of Brazil, in a recent lecture before the German Scientific Association on the state of culture of the people of the Stone Age in Brazil at the present day, described the Indian tribes on the Xingu, a Brazilian tributary of the Amazon. These people, he said, still belong to the Stone Age; they know nothing of metals, and use only stone, teeth, bones, and shells for their weapons, implements and ornaments, which they know hcw to carve with great artistic skill. They are now as they were in the time of Columbus, and have not changed in any degree since they were first discovered. They are, however, by no means savages; their customs are decent, they are monogamists, although there are no marriage ceremonies, and have the most affectionate relations with their children. Their mode of life is simple, but not barbarous, and there is not the least immodesty in their lack of clothing. The different tribes live in villages containing at the most 250 persons, near to the rivers, and usually some days' journey from each other. There is little communication between them. They are acquainted with the notion of private property, but it plays no great part among them, as the difference between the capacity for production of individuals is of the smallest. Thefts are sometimes committed from other tribes, but not in the same village. A great hindrance to development is the absence of all domestic animals, even dogs. The people hunt and fish, and, in a certain degree, carry on agriculture, but this latter is most primitive. They regard themselves as in close consanguinity with animals; the Bakari trace their descent to the jaguar, and the Trumai people, whom they hate, and who are expert swimmers, are believed to be a species of alligator, and to sleep at night at the bottom of the stream. The sun is to them a ball of the feathers of the red *ara* enclosed in a pot, the cover of which is raised in the morning and closed in the evening, and the other celestial phenomena are all connected in a similar way with the animal world. The sorcerer among them is a physician rather than a priest, he has no divine position, and indeed they have no notion of a Supreme Being. Soul and body are regarded as separate, for during sleep the latter is at rest, while the former wanders about at will. Hence a sleeper must not be awakened suddenly lest the soul should not have time to return. The language is not poor in expressions, and is scarcely narrower, says Dr. von den Steinen, than the speech of a German peasant in a remote place, but structure or system does not exist.

The Public Health.—The Registrar-General's return of births and deaths for the week ending Saturday, October 27th, states that the deaths registered in 28 great towns of England and Wales corresponded to an annual rate of 21·8 per 1,000 of their aggregate population, which is estimated at 9,398,273 persons in the middle of this year. The six healthiest towns were Birkenhead, Brighton, Bristol, Derby, Leicester, and Norwich. The highest annual death-rates, measured by last week's mortality, were, from measles, 1·4 in Leicester, 1·5 in Liverpool and in Leeds, 1·7 in Huddersfield, 2·2 in Portsmouth, and 3·8 in Cardiff; from scarlet fever, 1·0 in Leeds; from whooping-cough, 1·1 in Norwich; from "fever," 1·1 in Derby, 1·2 in Salford and in Sunderland, 1·3 in Halifax, and 1·9 in Cardiff; and from diarrhœa, 1·3 in Brighton, 1·5 in Portsmouth, and 2·0 in Preston. The 47 deaths from diphtheria in the 28 towns included 31 in London, 5 in Manchester, 2 in Nottingham, and 2 in Halifax. Small-pox caused one death in London and one in Preston, but not one in any of the 26 other great towns. In London 2,665 births and 1,737 deaths were registered. Allowing for increase of population, the births were 184 below, while the deaths exceeded by 104, the average numbers in the corresponding weeks of the last ten years. The annual death-rate per 1,000 from all causes, which had increased in the five preceding weeks from 15·8 to 20·0, further rose last week to 21·2, and exceeded the rate recorded in any week since the middle of March last. During the first four weeks of the current quarter the death-rate averaged 19·1, and was identical with the mean rate in the corresponding periods of the ten years 1878-87. The 1,737 deaths included 1 from small-pox, 100 from measles, 25 from scarlet fever, 31 from diphtheria, 18 from whooping-cough, 17 from enteric fever, 2 from ill-defined forms of continued fever, 30 from diarrhœa and dysentery, 1 from infantile cholera, and not one from typhus; thus, 225 deaths were referred to these diseases, being 26 above the corrected average weekly number. Different forms of violence caused 57 deaths; 53 were the result of negligence or accident, among which were 24 from fractures and contusions, 8 from burns and scalds, 4 from drowning, and 12 of infants under one year of age from suffocation. In Greater London 3,480 births and 2,102 deaths were registered, corresponding to annual rates of 32·9 and 19·8 per 1,000 of the estimated population. In the outer ring 11 deaths from diarrhœa, 9 from measles, 7 from whooping-cough, and 4 from "fever" were registered. Three fatal cases of measles and two deaths from "fever" occurred in Tottenham sub-district.

MARS AND ITS "CANALS."

(Concluded from page 453.)

(Concluded from page 453.)

WE have now to search for a rational explanation ot the phenomena described and figured. Not a few authorities, or at least authors, consider the canals as artificial. In their opinion these canals are immense engineering operations which have been executed by the inhabitants of Mars. All these canals, it will be perceived, form direct communication in a straight line between the seas, or between seas and other canals.

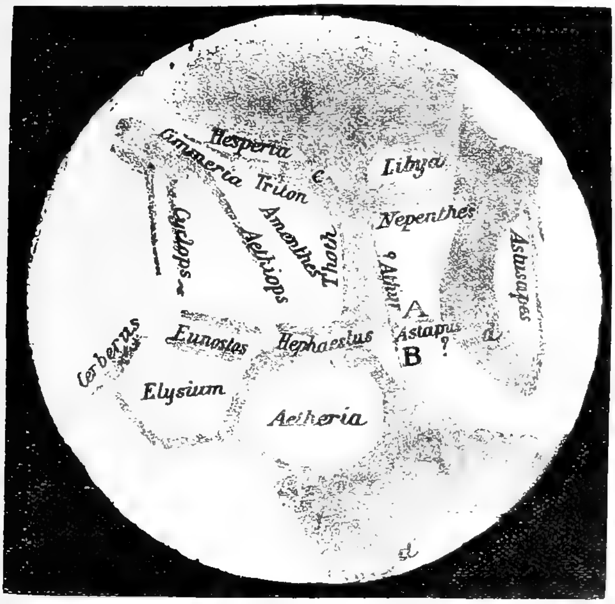

FIG. 4.—MARS AS IT APPEARED ON JUNE 12TH, 1888. (AFTER PERROTIN.)

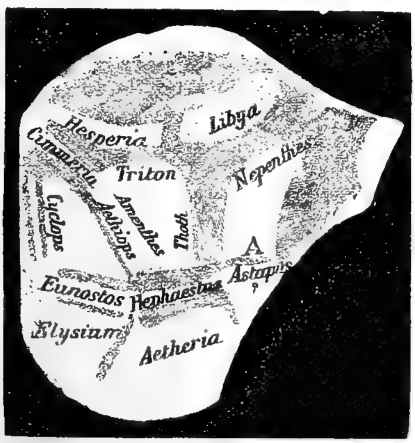

FIG. 6.—SKETCH OF MARS AS IT APPEARED ON MAY 8TH, 1888. (AFTER PERROTIN.)

None of them ever come to an end in the interior of a continent. Mars has for some years accustomed us to such extraordinary surprises that we do not protest against such an hypothesis, improbable as it may seem. For others the canals are gigantic rivers, but rectilineal rivers, passing invariably from sea to sea or from one watercourse to another, and never taking their rise in the continents! Men of science in our day are chary of using the word *impossible*, but here it almost appears justified. The late Proctor thought that the twin canals might be a phenomenon of diffraction, produced when fogs are suspended above the beds of the rivers of Mars. But this hypothesis leaves unexplained the difficulty of rectilinear rivers passing through the continents from sea to sea!

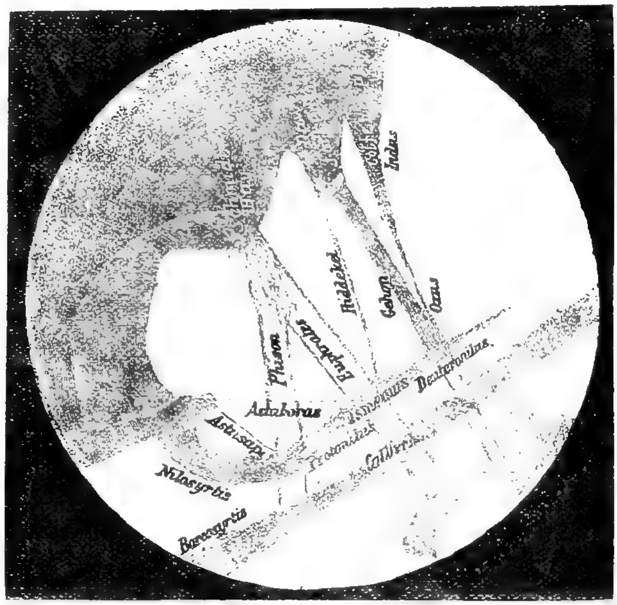

FIG. 5.—MARS AS IT APPEARED ON JUNE 4TH, 1888. (AFTER PERROTIN.)

M. Fizeau regards these canals as colossal *crevasses*, or chinks, in the glaciers of the planet. For him a glacial epoch reigns over the whole surface of the planet. The illustrious physicist has been led to this hypothesis by the presence of a dark line in the polar cap, as we have

FIG. 7.—SKETCH OF MARS AS IT APPEARED ON MAY 21ST, 1886. (AFTER PERROTIN.)

mentioned above. This canal seems to him to be a *crevasse*, such as we find in terrestrial glaciers; and as this fissure seems analogous to the other canals, these also would be fissures in an immense glacier.

M. Flammarion has shown various objections to the hypothesis of Fizeau. We believe we may conclude with him, from the melting of the snows at the poles, and from the difference between the polar regions and the rest of the surface, that Mars is not in a state of glaciation.

It may further be asked whether the system of canals and the great spots are sufficiently variable for this explanation. Changes have certainly been observed. In 1881-1882 the island Cimmeria was totally separated from the region. Amenthes now communicates with this latter between Ethiops and Lake Triton. Fig. 7 shows how M. Perrotin represented these details in 1886. Another change, apparently incontestable, is the enlargement of Lake Triton in 1888. The same may be said of Thoth. This canal in 1886 (fig. 7) is represented only by a small point prolonging Lake Mœris.

Still, these changes do not affect the grand network of canals. It is the same with the spots which, in their general configuration, are still what they were in 1659, when Huygens first described them in a characteristic manner.

However, as Schiaparelli very justly says at the end of his third Memoir, "To seek to found an explanation of these singular phenomena upon the scanty and incomplete data which have hitherto been collected would be rashness unparalleled and reprehensible. Yet we may notice that a tendency to gemination or doubling is manifested also in another manner on the surface of Mars. The division of Lake Ismenius, and that which separates Lake Niliacus from Mare Acidalium, seem to be instances of gemination. In like manner the existence of two bays of the Sinus Sabæus (Dawe's forked bay) and the two Atlantides belong to the same category of phenomena.

We may add some further details, such as the parallelism of the Sea of the Syrens, of the Cimmerian, the Tyrrhenian, and the Adriatic Seas; that of the Atlantides, of Cimmeria, Hesperia, Ausonia, and the lands of Japhet, Deucalion, and Pyrrha.

We even find two countries in Mars which seem to be copies one of the other. The Great Syrtis corresponds to the Gulf of Pearls, the Nilosyrtis to the Indus, the Astusapes to the Hydaspes, the Phison to the Jamuna, the Typhonius to the Hydraotes, the Horn of Ammon to the Promontory of the Aromes, Œnotria to the region of Pyrrha, Libya to the land of Deucalion. We may say that Tempe is modelled after Elysium, Styx corresponds to the sea Acidalium, Cerberus to Nilokeras, Eunostos to Nilus, Hyblæus to Ceraunius, Galaxias to Issedon, Cyclops to Ganges, Antæus to Hydraotes.

What should we say if we could be transported to Mars, and on observing the earth through a powerful instrument, could see, instead of a single Europe, two European continents, each exactly of the same form, traversed by rivers so identical that the two continents seemed copies the one of the other?

A. M. F. Serly says, "Never was a mystery more profound, an enigma more extraordinary, submitted to the human intellect."

Professor Holden, in a paper entitled *Physical Observations of Mars*, made during the Opposition of 1888 at the Lick Observatory, published in Gould's *Astronomical Journal*, denies the existence of these double canals, but as it seems impossible that so many skilled observers should have been deceived, we await, with great interest, the observations which will doubtless be made during the favourable opposition of 1890-1892, as they will probably assist in clearing up the mystery attached to these markings.

THE CONDUCTIVITY OF A VACUUM.

DR. E. EDLUNG has recently replied in Wiedeman's *Annalen* to the memoir of Dr. Foeppl on the electro-conductivity of a vacuum. He decidedly contests the cogency of Foeppl's experiments. His views are the following: Foeppl surrounded a spiral composed of glass tubes, and containing air highly rarefied, with a spiral of copper wire, through which a powerful electric current was transmitted. With this combination Foeppl was unable to recognise an induction-current in the glass spiral, whence he concluded that the highly rarefied air was not capable of conducting electricity.

Edlund cannot accept this conclusion. He writes: "It is proved experimentally that the electro-motive force excited in metals by voltaic or magnetic induction does not depend on the nature of the metals. This law holds good also for conductors of the second order; at least, it has been experimentally proved in the case of solutions of sulphate of zinc. The question now arises whether the same law extends to gaseous bodies—a question which has hitherto received no answer. Electrically, gases behave in a quite different manner from conductors of the first and second orders. In such conductors the potential difference between two points is proportional to the resistance between these points multiplied by the strength of the current. In gases, on the contrary, this difference is independent of the strength of the current. In metallic and liquid conductors the resistance is inversely as the section, but in gases it is equally great, whether the section is larger or smaller. Hence it appears very hazardous to ascribe to the constant of induction for gases, the same value as that for solid bodies, in default of any evidence, whether theoretical or experimental. Yet Foeppl's conclusion is based upon such an assumption.

Moreover, Foeppl calculates the strength of the current according to Ohm's formula, which is not valid for gases.

In favour of the conductivity of a vacuum, Edlund cites the fact that the strength of a current remains unchanged when the distance of the electrodes is increased from 1 to 30 centimetres. Further luminous phenomena can be elicited by influence in highly rarefied air, when the resistance decreases progressively to the utmost rarefication. The negative results obtained by Foeppl are due to the fact that the induction-constant of gases is too minute, as also that the electro-motive force of 5,000 volts which he calculates is non-existent.

THE TWINKLING OF THE STARS.—According to *Ciel et Terre*, in all parts of the sky the scintillation is strongest in winter and weakest in summer. In every season of the year it is more marked in the north than in other directions. Except in summer, it is stronger in the east than in the south and the west. The mean intensities of scintillation corresponding to the four seasons follow regularly the variations of their mean temperatures.

DEEP SEA FISHING.— M. Fol (*Comptes Rendus*) has attempted to fish at the depth of 800 metres by sending down nets fitted with tubes charged with phosphorescent sulphide of calcium. Unfortunately, the pressure had broken almost all the tubes, and the experiment has thus miscarried. M. Fol proposes to renew the attempt.

Natural History.

NATURAL SUCKERS.

ALTHOUGH we do not meet with it among the mammals or the birds, the sucker in some of the lower forms of life is of considerable importance, not only in the capacity of a weapon, but also in that of an organ of locomotion, as well as of a means by which locomotion may be checked. Thus, to adduce but one example in illustration of each method of employment, the suckers of the cuttle-fish are weapons of offence, those of the gecko render possible the employment of the limbs under unusual circumstances, while a similar organ in the gobies serves as an anchor, by means of which its possessor may defy the fury of the waves. And in each of these cases the construction of the sucker, and of the apparatus connected with it, is well worthy of examination.

Let us take, in the first place, the tentacles of the common octopus, or poulpe, by means of which it seizes its victims, and drags them closely and more closely to its body, until its strong curved beak can be plunged into their flesh. Each of these tentacles is studded with an array of no less than one hundred and twenty pairs of suckers, every one of which constitutes a most perfect air-pump, the more powerful and effective by reason of its employment under water. And all these manifold suckers are entirely under the control of their owner. The principle upon which they are constructed is very simple. "The adhesive disc itself," says Rymer Jones, "is composed of a muscular membrane, its circumference being thick and fleshy, and in many species supported by a cartilaginous circlet, so that it can be applied most accurately to any foreign body. In the centre of the fleshy membrane is an aperture leading into a deep cavity, at the bottom of which is placed a prominent piston, which may be retracted by muscular fibres provided for the purpose. No sooner, therefore, is the circumference of the disc placed in close and air-tight contact with the surface of an object, than the muscular piston is strongly drawn inwards, and, a vacuum being thus produced, the adhesion of the sucker is rendered as firm as mechanism can make it."

GECKO.

In some of these singular animals the ordinary suckers, powerful as they are, do not seem to be sufficient, and are reinforced by others of a different character, situated upon two additional tentacles. Each of these bears a strong and sharp hook, which is forced deeply into the flesh of the victim by the mere pressure of the sucking-disc, and thus the sucker practically consists of two wholly distinct weapons, each of a highly formidable character. This structure is especially noticeable in the *Onychoteuchis*.

And there is another point connected with these additional tentacles which must not be overlooked, for each is provided with a small group of adhesive discs of the ordinary character. And for this reason: Sometimes a victim is seized which, although it cannot break away from the hook-armed suckers, yet struggles so violently that it cannot be drawn sufficiently near to the body for the employment of the beak. In such cases both the long tentacles are brought into use, and, adhering closely *together* by means of the simple sucking-discs at their extremities, supplement one another, just as we ourselves employ both arms to drag to us an object which neither alone is sufficiently strong to move. And after the victim has been drawn up for a little distance, the shorter tentacles also are employed, and its doom thus sealed.

These singular suckers—those of the simple kind, that is—combine in themselves all three of the functions referred to at the commencement of this paper, for not only are they employed as weapons, and weapons of the most formidable character, but they are also used both in locomotion and as anchors by which their owner may cling to a rock or stone.

What the precise function of the sucking-disc of the Remora (*Echeneis remora*) may be is still altogether unknown; but it is nevertheless a most singular piece of mechanism. Lying on the upper surface of the head, it consists of a number of flat, bony laminæ, arranged side by side very much after the manner of the laths of a Venetian blind, and capable of being raised or depressed at the will of their owner. The edge of the disc itself is soft and fleshy, and when this is placed in contact with any smooth surface, and the laminæ are depressed, a vacuum is formed, causing the fish to adhere so tightly to its hold that scarcely any amount of force will detach it. In this manner the fish will affix itself to whales, turtles, sharks, and many other of the larger inhabitants of ocean, being carried by them for immense distances through the water, apparently in total ignorance of its presence.

This strange sucking organ would appear to be a modification of the first dorsal fin, the bony laminæ by which the vacuum is caused exactly corresponding in number to the spines. But as regards the object of its presence we are altogether in the dark. It cannot be merely an aid to locomotion at the expense of other fish, etc., for the remora is a good swimmer, and is at least as swift and active as are many of its fellows; and there seems to be no reason why it should wish to pass through the water with unusual speed. Nor does it appear to find any difficulty in procuring food, for when a specimen is killed and examined its stomach is nearly always full. Possibly the disc is employed as a means of *defence*, the fish attaching itself, when in danger, to some creature of far greater size, and thus putting itself, as it were, under protection. We do not know. One would think, from its highly developed condition, that the organ in question must have some special function, but of what nature that function may be has so far passed the wit of man to ascertain.

The *Discoboli*, or quoit-fishes, are provided with a somewhat similar sucker upon the ventral surface of the body, formed by a modification of the ventral fins, and capable of holding so firmly that one of these fishes which had affixed itself to the bottom of a pail of water still retained its hold when lifted by the tail, though it was consequently obliged to sustain the weight both of the pail and the water. The ventral fins of the gobies are modified in very much the same manner.

The lamprey possesses an excellent sucking organ in its mouth, and employs it not only for mooring purposes when the current is strong, but also for removing stones, etc., from the spot in which it wishes to lay its eggs. And the leech, although so widely removed in the zoological scale, has a mouth of very similar character, but armed with teeth capable of penetrating the skin of any animal to which it may affix itself.

The suckers upon the foot of the gecko, which terminate each of the toes, are employed solely as aids to locomotion, enabling their owner to ascend a perpendicular wall, or to creep head downwards across a ceiling, with perfect ease and safety. And thus the animal is able to capture its insect victims under conditions which would place them in almost absolute safety from all other foes. Something of the same kind we find in the feet of the house-fly and its allies, but in these true suckers are wanting, and the flat disc of the foot adheres to a wall or ceiling merely by reason of a strongly glutinous fluid which it secretes; and, as the feet are lifted obliquely, they can be removed from their hold without the slightest difficulty.

Quite an array of true suckers, however, we find in the anterior feet of the male great water-beetle (*Dyticus marginalis*). These are of two kinds, two large ones being situated upon the foot itself, while the remainder, which are very numerous and much smaller, are set at the extremities of slender foot-stalks, and look something like inverted mushrooms. Upon the intermediate feet, also, there are a few of these suckers, although the basal joints of the tarsi are not swollen into large fleshy pads, as are those of the front pair. In the female insect they are altogether wanting.

Finally, we have examples of the sucker structure in the bases of sea-anemones, by means of which they attach themselves to rocks, and also in the "feet" of to such molluscs as the limpet, which can cling so firmly their hold that it is very difficult indeed to remove them.

It will be noticed that in the great majority of cases these natural suckers are possessed by aquatic creatures, to which they would obviously prove more useful than to those living upon dry land; for the employment of a sucker under water signifies not only the atmospheric pressure of fifteen pounds upon the square inch of surface, but also the pressure caused by the water itself. And it also follows that the greater the depth at which they are employed, the greater the force involved. Thus the cuttle fish is able to hold creatures which in the air above would easily break away, and the remora to withstand force which, were it lifted from the water, would suffice easily to drag it from its hold. But the suckers even of such creatures as the gecko are tolerably powerful, and cannot be detached save at the expense of some little force.

Edible Birds' Nests.—Mr. Steere, a traveller in the Philippine Archipelago, in the course of a paper in the *American Naturalist*, descriptive of the central islands of the group, refers to certain caves in the Island of Guimaras where edible birds' nests are found. The bird which builds these nests is a species of swallow or swift, and the caves are not found opening on the sea, but far inland where the cavities are covered by vegetation. Guided by an old Indian whose livelihood was obtained by gathering nests, and provided with a torch of native gum and another of the ribs of cocoa palm leaves, Mr. Steere started for the caves. After half an hour's rapid tramping through the steep, rocky valleys, he came to a low ledge of rock, 8 feet or 10 feet high, covered with vines and bushes, at the foot of which was a black hole, just large enough to crawl through, leading down into the earth. After lighting the torches, the party crawled on hands and knees down a steep, rocky, narrow passage, the channel of a stream in the rainy season. It was simply a rift in the rocks, produced, perhaps, by an earthquake. Gradually all light except that from the torches disappeared, and when about 100 feet below the ground and several hundred from the entrance, the weak, faint twittering of little birds as they flew about overhead was heard. When the Indian raised his torch, shallow hollows were seen in the roof of the cave, in which, partly supported by the sides, were the little cup-like nests. They were pure white in colour, made of little fibres interwoven with each other, and were still soft and damp. It was surprising how the birds ever found out a place so far from the light, with a dry face of rock and suitable depressions, or how they could build the nests in such utter darkness. A second cave, not far off, was entered by a kind of well, and the curious, faint noise of the birds underground is described as "more like the sounds spirits make than the notes of anything earthly." Near the mouths of the caves were rougher nests, built also of the same edible gum, and said to be those ot birds who gave warning of danger to those within. The young frequently attach their nests to those of their parents, and the same nest is used year after year. In these caves the nests are collected and sold to the Chinese in Ho Ho. It should be added that the caves here described by Mr. Steere are of quite a different character from the far-famed Gomanton caves in British North Borneo, which are the principal source of the supply of edible birds' nests. These stupendous caves are quite open, and are as lofty as a cathedral aisle, so that the nest-gatherers have constructed ladders and galleries of rattans to reach the nests in the roof. A curiosity of these caves also is that they are inhabited by myriads of swallows by night and of bats by day, the latter swarming out in clouds as the former swarm in, and *vice versa*.

The Great Lacewing Fly.—This beautiful insect, which is known in scientific parlance as *Osmylus chrysops*, is the largest of the British *Planipennia*, which includes the lacewing flies, scorpion flies, and stone flies, generally called true neuroptera (*Neuroptera genuina*). They are principally distinguished from the *Pseudo neuroptera* (the dragon flies, day flies, and the white ants, etc.) on account of their metamorphoses, which are complete or perfect, while in the latter they are imperfect. The insect under consideration measures about an inch and a half to two inches in expanse of its wings, which are beautifully veined and reticulated with a few brownish patches in different places. Its general appearance much reminds one of a small Anthori, or *Myrmelion*, several species of which abound on the Continent. The *Osmylus chrysops* is generally a local insect in this country, occurring only in the vicinity of streams, particularly in woods. It usually flies during the sunshine, which is not universally the case with lacewing flies. About half a century ago this species was considered such a rarity that the price for it in dealers' shops in London was half a sovereign for a pair. A very excellent illustration of this interesting insect is given in Donovan's "British Entomology."

Sorting Coloured Wools when Blindfolded.—Under this title a correspondent of *Science* writes: Your reviewer considers that the experiments of Professor Fontan, in which a hypnotised subject sorted coloured wools with his fingers when his eyes were completely covered, are simply incredible. It is true that they are so hard to believe in that a single instance can produce scarcely any effect at all, but they cannot be considered as absolutely incredible in view of the fact (?) that Professor Vitus Graber has shown *that so thick-skinned an animal as the cockroach reacts to colours when his antennæ have been removed and his head has been covered with a thick coating of black sealing-wax.*

The Great Skua.—Twelve eggs of the great Skua (*Lestris catarractes*) known as the Bonxie, were recently exhibited in a shop window in Kirkwall. The bird is believed to be nearly extinct. The eggs are a light brown, with dark chocolate spots; length of eggs, 2¾ in.; breadth at broadest part, 2 in. This bird is known to breed nowhere in Scotland but in Foula, near the Shetland Isles, and there they are very scarce.

Horse Protecting a Goat.—The following remarkable illustration of the sagacity of the horse comes from the *Birmingham Mail.* A man named Gilbey, a coal dealer and haulier, rents a field adjoining Gillott-road, Edgbaston, in which a horse and goat have been in the habit of grazing. Recently a gang of young roughs from the Icknield Port Road have amused themselves by throwing stones at the goat, and some of the more cowardly of the ruffians beat it with a stick. Whenever the goat has been attacked in this way the horse has always raced to its rescue, and a few days ago he seized one young rascal by the collar and flung him over the hedge into the road.

Tasmanian Earthworms.—Mr. Morton, at a meeting of the Royal Society of Tasmania, exhibited some splendid earthworms ranging from 2 to 3 feet in length. They are considered to be of a new species, and probably to represent a new genus.

The Egg of the Echidna.—Mr. A. Morton (Royal Society of Tasmania) gives an elaborate account of the anatomy and ontology of this curious animal, confirming Mr. Caldwell's description, and showing that in 1849 the aborigines were perfectly aware that the *Echidna* produced eggs. The egg is described as being three-quarters of an inch in length.

An Eighth Sternal Rib.—Dr. Lamb, of the United States Army Medical Museum (*Science*), has observed in a number of human specimens an eighth rib, the cartilage found below the seventh rib being fully developed into an eighth rib. This abnormal (or reversionary ?) phenomenon occurs, as far as Dr. Lamb has observed, among negroes. One case has been found in a Red Indian.

The Periodicity of Insect Ravages.—Mr. A. H. Swinton has pointed out that the years notable for swarms of locusts are identical with those when the sun-spots are at a minimum.

Reviews.

Proceedings of the Royal Society of Edinburgh. Session 1887-88. No. 126.

In the Chairman's opening address we observe the statement that the library of the Society is "the most complete collection of its kind in the United Kingdom; more complete even than that of the Royal Society of London."

We observe with pleasure the creation of a Victoria Jubilee Prize by Dr. Gunning. This prize is to be awarded every three years for scientific research, either done during the past three years, or to be conducted during the three years ensuing.

Referring to the defective state of the Edinburgh Observatory, the speaker regretted that work similar to that which is now being done for the southern heavens at the Cape Observatory is at present not in hand either at Edinburgh or London.

Mr. Piazzi Smyth calls attention, with particular reference to the service of the Edinburgh Observatory, to the scanty remuneration awarded to scientific servants of the British Government, in comparison with the salaries allotted to mere "quill-drivers." In an advertisement the salary of £100 yearly is offered to a second assistant astronomer at the Royal Observatory at Edinburgh—who, in addition, is to be chosen, not *rebus gestis*, but by the absurd scheme of "open competition"—whilst in another announcement appearing on the same day, £250 yearly, rising to £600, is offered to each of two junior clerks in the Colonial Office!

We find here the second part of "Researches on Micro-Organisms, including ideas of a new Method for their Destruction in Certain Cases of Contagious Disease," by Dr. A. B. Griffiths, F.R.S.E.

In this most valuable memoir, the author draws the following conclusions, which seem legitimate inductions, from the facts described. It has been proved beyond doubt that microbes are the real cause (we add here, "direct" or "indirect") of certain contagious diseases. In many cases these microbes are capable of being destroyed by various germicides. Therefore, by further investigation, we ought to find a germicidal remedy for such terrible scourges to humanity as consumption and syphilis. The vitality of *Bacillus tuberculosis* is considerable, and it is capable of being dried up in the atmosphere for many weeks without its vitality being impaired. It is even capable of being disseminated by envelopes coming from phthisical patients. The electric current destroys the vitality of certain microbes. The soluble zymoses secreted by living microbes are capable of being destroyed by germicidal agents. The germicidial agents used for injection must not produce poisonous actions upon the blood and tissues, yet they must be powerful enough to destroy the vitality of the microbes and their spores.

Professor R. Wallace communicates a memoir on the "Colour of the Skin of Men and (Lower) Animals in India."

The author notes that in India, cattle, sheep, pigs, buffaloes, and horses, whatever the colour of their hair, have black skins, and of this fact he seeks the explanation.

New Fibre from the Stalk of the Cotton Plant.—According to *Science*, the stalk of the cotton plant yields a fibre fit for all the uses to which hemp is put.

Abstracts of Papers, Lectures, etc.

LIVERPOOL SCIENCE STUDENTS' ASSOCIATION.

The opening meeting of the winter session of this Association was held at the Royal Institution on the 19th ult., After the introductory business had been concluded, Mr. F. P. Marrat exhibited a case of specimens from his fine collection of agates, and described the various modes of formation of these beautiful silicious minerals.

Miss E. N. Wood next gave a *résumé* of the botanical work of the summer session, which had been fruitful in the acquisition of several floral rarities by those members who attended the various field meetings.

The President (Mr. Osmund W. Jeffs) then delivered the annual address, alluding in the first place to the work already accomplished by the Association, and indicating several directions in which its future vigour and usefulness might be developed. The study of biology was referred to as possessing a wide range amongst the natural philosophies. It was the *raison d'être* of the naturalist, and interested alike the student of to-day and of the long past. There was scarcely a spot which did not yield some vestige of the presence, at some time or other, of that active principle called "life," and a study of this science opened our minds to some of the highest and most reverential ideas of which the human intellect was capable. Anthropology, or the natural history of the human species, also deserved careful study, for the furtherance of which special facilities existed in Liverpool, where the different racial types from all quarters of the globe met together; and closely connected with this was archæology—the science of ancient things—a kind of *via media* between anthropology and what was generally classed under the term of "history." Both in connection with this subject and with natural science much assistance could be obtained by students from the admirable collections displayed in the Free Public Museum. There was a growing feeling that a museum should be something more than a storehouse of curiosities; it should be a more direct means of conveying knowledge. Viewed in this light, the educational value of a museum became much enhanced, a fact which doubtless had its share in inducing the local authorities to open the Public Museum on Monday evenings. The remainder of the address dealt with the geology of the Cheshire hills. The subject of the origin of hills and mountains had lately received renewed attention at the hands of geologists, with the result that one more magnificent conception had been added to the list of geological theories. The author of the new theory was Mr. T. Mellard Reade, F.G.S. Discarding the old hypothesis that mountain ranges were caused by contractions of the crust following upon a shrinking nucleus —a hypothesis which on mathematical grounds was demonstrated to be insufficient—Mr. Reade urged local expansions in those parts of the crust subject to a rise of temperature through sedimentation. In the limits of an address it was impossible to do justice to Mr. Reade's theory, which was borne out by an exhaustive series of original experiments, but it was suggested that a reference to the work itself would convince students of the importance of the physical effects pointed out by the author. Our local hills were rather the result of denudation acting upon little disturbed strata of the triassic age. The President remarked that the observer of scenery could not fail to be interested in the question of the origin of our hills. For the history of their formation they must look to those physical operations slowly, but surely, changing the form of the earth's surface. The older theories of violent upheavals could now no longer be admitted. The history of the opinions held regarding denudation was then traced from the early "cataclysmal school" to Lyell's marine theory, and the more modern views of the sub-aërial geologists (really the result of Hutton's teaching in 1795, the application of which has long lain dormant), who had shown that the ordinary operations of rain, rivers, and ice—slow in progress, but constant in action—were sufficient to account for the formation of hills and valleys, without having recourse, on the one hand, to violent disturbance of the strata, or, on the other hand, to exclusively marine action. The theory of escarpments and of longitudinal and transverse valleys was then touched upon, and local instances cited in illustration. A line of escarpment extends from Overton Hill, above Frodsham, to Helsby Crag. The steep sides face the north-west, the gentle slopes of the hills being in the direction of the "dip" of the rocks. A miniature instance of a "transverse gorge" is also seen here. The scarped faces of the Peckforton Hills, so prominent a feature in the scenery of the district, were shown to be due to ordinary sub-aërial operations, aided by faults which have brought down the hard keuper basement beds, leaving the softer beds of the upper bunter exposed to denuding influences. The softer rock being more rapidly worn away, the hard keuper rock falls down. This process can be seen in action. In many places on the hills the uppermost keuper beds overhang the bunter rocks, of which the slopes of the range are composed. The important influence of faults in modifying the shape of the ground was explained, but the speaker opposed the theory that valleys always coincided in direction with faults and fissures in the crust of the earth. Referring to the marine theory of denudation, which some writers had brought forward to explain the origin of these escarpments, it was pointed out that the hills of Peckforton present all the features of escarpments due to sub-aërial denudation; and when that was known to be sufficient to produce the effects which we now see there was no necessity to bring to our aid supposed prevalent winds or extraordinary powers of marine breakers. In considering the origin of surface features, it should be remembered that the existing configuration cannot have been of long duration, geologically speaking. The present surface is connected with former systems of hills and valleys, which (if only they could be reconstructed) would help us to understand how the existing outlines attained their shape. Since the deposition and upheaval of the triassic rocks, immense masses have been removed from the surface, the shape of which must have constantly been altered, so that the original lines have been lost for ever. Some geologists are apt to forget this, and they construct maps to show the positions of land and sea during various periods of the earth's history upon evidence which is insufficient to entitle them to pronounce so positively on what is a purely speculative matter. The hills of Wirral were then described, including Storeton Hill (famous for its labyrinthodent footprints), Bidston Hill, Flaybrick Hill, and on the other side of the peninsula Thurstaston Hill, where there is another instance of an escarpment the formation of which can be seen in progress. Near the top of the hill a well-defined band of hard quartzose rock is seen. Underlying this is a bed of soft sandstone, which is rapidly worn away, and in course of time a further scarped face will be apparent, resembling those of Delamere and Peckforton. Thurstaston Hill is intersected by numerous faults, to which may, in all probability, be attributed the isolation of that rectangular block of sandstone to which archæologists have given the name of "Thor's Stone." In was pointed out, in conclusion, that the district around Liverpool was not so devoid of geological interest as many supposed. In geology there was still much to be learnt, and there were many difficulties yet to be explained. It was only by the patient observation of ever-acting nature that they could hope to decipher the past physical history of the earth; and when they reflected upon what the energy and labour of their local workers had already accomplished they might rest undisturbed by conflicting theories, and look forward with increased confidence to the discoveries of the future.

LIVERPOOL GEOLOGICAL SOCIETY.

THE annual meeting of this Society was held on the 9th October, in the small lecture-hall at the Royal Institution, the presidents, Mr. H. C. Beasley, in the chair. After the transaction of preliminary business, the usual balloting for the Council took place. The President (Mr. Beasley) and ex-President (Mr. G. H. Morton, F.G.S.) do not retire this year. The remaining officers elected for the ensuing session were—Vice-President, Mr. F. P. Marrat; Hon. Treasurer, Mr. E. M. Hance, LL.B.; Hon. Secretary, Mr. W. Hewitt, B.Sc., and members of the Council, Messrs. J. J. Fitzpatrick, C. Ricketts, F.G.S., T. Mellard Reade, F.G.S., O. W. Jeffs, and the Rev. S. Gasking, B.A.

The President, in his annual address, dealt in a very graphic and interesting manner with the geology of the district around Liverpool. After congratulating the Society on the work of the last twelve months, he proceeded to show that a large number of unsolved questions relating to our local geology awaited the attention of members of the Society. There was, he said, no ground for the statement so often expressed in the past that the neighbourhood of Liverpool afforded few features of interest to those whose aim it is to investigate the strata upon which we live. On the contrary, Liverpool formed an admirable centre for geological field work, and was especially rich in facilities for the study of the glacial and post-glacial beds and the phenomena connected with them. In the triassic strata of Lancashire and Cheshire, again, there were abundant opportunities for studying a series of formations about which a great deal has been written, but which presented many points of interest still comparatively unworked. Referring to the paucity of remains of animal or plant life in the triassic rocks, the President counselled further and more minute investigation of the keuper strata, with a view to the discovery of the fossilised remains of the bones of those Saurians and other animals whose footprints are found recorded in the rocks at Storston and many other places in the district. So far no remains of the animals themselves had been found in local strata nearer than the keuper sandstone of Shropshire. With regard to the bunter rocks, there was little hope of any such remains being found. A question which had been agitating physical geologists for some time was that of the origin of the new red sandstone. The beds, as developed around Liverpool, might be divided into four divisions—marine, estuarine, lacustrine, and riverine; and some points recently brought forward by Professor Bonney would seem to indicate that many of the bunter rocks may not have been deposited in deep water. Throughout the pebble beds the pebbles are of a peculiar character, being well rounded, and usually differing entirely in composition from rocks of local origin. At a section exposed on the west side of Hilbre Island a conglomerate bed of remarkable character was found, many of the pebbles in which appeared to have been derived from the carboniferous rocks. There had recently been some difference of opinion expressed as to the age of this bed, which the survey regarded as a part of the bunter, though it had lately been classed as a basement bed of the keuper. The speaker invited the attention of members to this interesting section, and proceeded to refer to several local indications of sandstone beds having been accumulated as æolian deposits by the action of wind. Attention was also drawn to the strata as exhibited at Flaybrick Hill, where the junction of the lower keuper and the upper bunter is well developed. The address concluded with an appeal for members to take advantage of the many opportunities constantly occurring in the opening of new railway and canal cuttings, borings for water, and other sections, a careful study of which would frequently be found to throw new light on what has been previously learnt as to the stratigraphy and physical features of the country around our own homes.

NEWCASTLE SOCIETY OF ANTIQUARIES.

At the meeting held on Oct. 31st, the Rev. Dr. Bruce presiding,

The Chairman called attention to Hodge's account of the Abbey Church of Hexham. He said that he had long been acquainted with that very beautiful structure, the Hexham Abbey Church, which was one of the finest specimens in England of the early British style, a style which to his mind was better adapted for the construction of places of worship than any other. This very interesting structure had met with one who could really reveal to them its beauties. In the work he had mentioned they had very magnificent drawings of this very elaborate structure, and an account of all the beauties of it which would afford to any one who studied it an amount of interest and instruction that could rarely be met with. He did not believe there was any architectural structure in Britain that was so well and so fully described both by letterpress and by plates as this one, and he was glad to say that the work was the work of one of their members. He would strongly recommend every architect and every antiquary to get a copy of it.

Mr. John Philipson read a paper on *Vitality of Mummy Wheat and Seeds taken out of the Wrappings of Egyptian Mummies.* He said: It may be remembered that at the monthly meeting of our society on September 28th last year, some conversation which passed between the chairman and the late Captain Robinson came near reviving the far-famed controversy respecting the germinating possibilities of mummy wheat, in the same manner that it had been renewed by Professor Judd at the Geological Society, early in the summer of 1886. I confess to a more than ordinary interest in the subject, as I was aware of some instances of reputed mummy wheat having been successfully grown in our own locality; but as I am not one of those who venerate the story simply because it is old, I set to work to collect such evidence as might explain two problems that presented themselves, viz.: 1st. Would seeds retain their germinating powers during a period of 2,000 or 3,000 years? and 2nd, have plants ever been raised from such seeds? The whole matter turns upon the character of the seeds which have been discovered in the folds of mummy wrappings. I have ample proof that plants have been raised from such seeds not only in the south of England, but in this neighbourhood, and it only remains for the spurious or genuine nature of these seeds to be decided to set the matter at rest. It is, of course, impossible to obtain *absolute* proof in such a matter; but there are those who have not hesitated to assert that the Arab, with his characteristic cunning, has placed modern seeds within the folds of the mummy cloths. Nothing s easier than to make a declaration of this kind. Crafty, though he may be, the Arab would not take this trouble until he knew that there was something to gain by it—*i.e.*, until he had heard of the finding of *genuine* seeds, and the interest evoked by their discovery. There were, however, three cases in which the receptacles—two sarcophagi and a vase—could not possibly have been tampered with, and the knowledge of these instances have encouraged me to follow up the subject, with the result that I am able to lay before you what I consider sufficient evidence to prove that what is known as mummy wheat has been raised from seeds more than 2,000 years old. Mr. Philipson then entered in detail into the evidence referred to.

CAMBRIDGE ANTIQUARIAN SOCIETY.

At the meeting held on the 29th of October, Professor A. Macalister, M.D. (President), exhibited some specimens of Roman pottery found in the excavations made for building purposes in the Madingley Road. The most perfect of these was a fragment of Samian ware with a figure of a deer. Nearer the surface a silver halfpenny of Edward III. was found. Most of the pottery was found in a pit of black earth, evidently the trace of an old excavation in the gault.

Mr. J. W. Clark exhibited a skeleton of a Red Deer (*Cervus elaphus*), lately mounted by his assistant, and placed in the Museum of Zoology and Comparative Anatomy. The bones were found in December last in a deposit of peat at Manea, on the estate of William Wiles Green, Esq., who kindly presented them to the University. This skeleton is the largest, of a full-grown animal, yet found in a complete state, measuring four feet from the ground to the top ot the dorsal spines. A skeleton of an adult Scotch stag, exhibited by the side of it, measured only three feet four inches.

The President remarked that the late Professor Jukes described and figured in the proceedings of the Geological Society of Dublin a skeleton of a red deer of unusually large size from Bohoe, Co. Fermanagh, and with fourteen pairs of ribs. Another very large red deer skeleton from Co. Limerick is in the National Museum of Dublin. Mr. Green mentioned that a bronze coin of Vespasian had been found in the immediate vicinity of the deer-bones, and invited members of the Society to come and co-operate with him in investigating the spot.

The Rev. E. G. Wood read an elaborate memoir upon the University at Stamford.

Highbury Social Guild.—On October 30th the first lecture delivered in London on the "Perfected Phonograph" was given under the auspices of this guild by Sir Albert K. Rollit, LL.D., F.R.A.S., M.P. The Rev. Dr. Allon presided, and amongst those present were Colonel Gourand and Mr. Hamilton (representing Mr. Edison. The lecture was illustrated throughout by interesting and successful experiments in acoustics, with sensitive and manometric flames, microphones, telephones, various phonographs, etc. Sir Albert, after sketching the career of Edison, and explaining the principles which Edison had practically applied in the invention of the phonograph, said it was in 1877 that the magnificent step had been taken which had led to the evolution of the new instrument. Its purpose was to register the different vibrations produced by speech, and to reproduce the words in correspondence with the registered tracings. Phonograms would become, he did not doubt for a moment, a matter of ordinary correspondence through the penny or parcels post. The phonograph as a medium of correspondence was always audible and legible. One could not say the same of personal handwriting. Immense possibilities were opened up by the belief of Edison that there would ultimately be a combination of the telephone and phonograph with which they would have a messenger or clerk who could make no mistakes.

Essex Archæological Society.—On October 26th the members of this Society paid a visit to Coggeshall. Mr. G. F. Beaumont exhibited a number of Saxon relics found at Kelvedon in March last. These included a knife, a fork prong, hair pin, ring, and hinge, all highly oxidised, together with a small Saxon javelin head and a straight sword heavily embossed with the rust of centuries. Mr. Beaumont also exhibited a small bronze Virgin and child; a square red drain pipe, possibly as old as a Roman aqueduct, found near St. Nicholas' Chapel, Coggeshall; two cinerary urns, and a weaver's shuttle. Major Hamilton produced two handsome stone axes, found near Kelvedon. Mr. G. F. Beaumont followed with an interesting description of relics which have been found near Coggeshall and Kelvedon; after which Major Hamilton referred to the many Roman remains which have been found near Rivenhall Church and on Crane's-hill, between Witham and Kelvedon.—Major Hamilton said recently, at Braxted, he saw a lady executing some needlework, the pattern of which had, she stated, been copied from that of the tiled pavement in Prior Cranden's Chapel at Ely. He recognised that the pattern corresponded with that of the pavement in the Pilgrims' Chapel at Little Coggeshall. Now, he found that about the 13th century the Bishop of Ely came to Coggeshall to settle some dispute about tithe, and he probably carried back with him to Ely some of the pavement of the Pilgrims' Chapel. It was a Cistercian pattern, plain, and with little ornament.

Physical Society of Glasgow University.—At a meeting held on October 26th Mr. G. G. Henderson, M.A., B.Sc., read a paper on "The Determination of Molecular Weights," in which, after referring to the well-known methods, he directed special attention to the important researches of Raoult on the laws governing the freezing-point of dilute solutions, the outcome of which is a new process for determining molecular weights, which is of almost universal application to organic substances. The great value of Raoult's method lies in the fact that by its application it is now possible to determine the molecular weights of substances whose character renders a determination of vapour density impossible —the carbo-hydrates, for example. The process is based on Raoult's general law of congelation—viz., "If one molecule of any substance be dissolved in one hundred molecules of any solvent the freezing-point of the latter is lowered 1·63° C."—and is a very simple one, involving the use of no complicated apparatus. Till recently chemists have not given this discovery the attention which it deserves, though it is, without doubt, one of the most important additions to the supply of physical methods applicable to chemical research since the enunciation of the law of Dulong and Petit.

Bristol Microscopical Society. — The forty-fifth annual meeting was held on October 5th, when the following officers were elected: Dr. Harrison, president; Professor Leipner, F.Z.S., and Mr. E. B. L. Brayley, F.R.M.S., vice-presidents; Mr. C. K. Rudge, hon. librarian; and Mr. H. A. Francis, hon. secretary. The retiring president, Dr. Hudson, Pres. R.M.S., in his annual address, congratulated the Society upon its flourishing condition, and also read a letter of thanks from the Bath Microscopical Society to the Bristol men for the great assistance rendered to Bath on the occasion of the soirée given to the British Association. Several members exhibited rare and interesting specimens, Mr. C. K. Rudge showing discs of *Liparis Montagni* and *Cyclopterus*, also epizoa of dogfish, Mr. F. W. Stoddart a section of wall of subcutaneous abscess in glanders, Mr. Brayley a very rare mite, *Glyciphagus plumiger*, and Dr. Hudson a very rare rotifer, *Esplanchna ebbesbornii*, found only near Salisbury, England, and at the Botanical Gardens, Sydney, Australia.

The Leeds Naturalists' Club and Scientific Association.—At the meeting on October 22nd the subject of the evening—"Plant Structure"—was entered upon, under the chairmanship of Mr. F. W. Branson, F.C.S., who gave some account of the structure of *Pilularia globulifera*, an interesting cryptogamous plant, the reproduction of which is effected by spores. The sporocarp and the macrospores and microspores were very beautifully shown in section, as was also the structure of the stem, and attention was called to the species as being the only British one possessing both classes of spores.

Leyburn Literary and Scientific Society.—On October 19th this society held its annual meeting. The president, Mr. H. Arthine, sen., occupied the chair. The secretary (Mr. F. Potter) produced his report, which stated that during the past session nineteen papers were given embracing different subjects, while in the previous session only twelve papers were read. The meeting then elected Colonel Wray, hon. president; Mr. H. Arthine, sen., president; Mr. W. Horns, F.G.S., vice-president; Rev. P. K. Bircham, Mr. C. Horner, and Mr. L. Paisley, members of the council; Mr. H. Horne, treasurer; and Mr. F. Potter, secretary.

Old Kirkpatric Naturalist and Antiquarian Society.—A very successful conversazione was held by this Society on October 26th.

The Bradford Philosophical Society.—On October 25th the session of the Bradford Philosophical Society was inaugurated with a lecture by the president, Mr. A. R. Binnie, on "Heat in Relation to Coal."

LIVERPOOL NATURALISTS' FIELD CLUB.—On October 26th this club held a conversazione which proved a great success. Amongst the exhibits were two yellow love-birds, shown by Mr. William Cross, and some living Longicorne beetles.

LIVERPOOL GEOLOGICAL FIELD CLASS.—On October 27th the members of this class, under the guidance of Mr. Lomas, lecturer on geology at the University College, and Mr. H. C. Beasley, President of the Liverpool Geological Society, visited Wallasey and Poulton.

ISLE OF MAN NATURAL HISTORY AND ANTIQUARIAN SOCIETY.—At the monthly meeting held on October 11th, Deemster Gill, the President, read his report, as delegate, of the British Association meeting at Bath. The question of publishing a quarterly report was considered, and a list of Manx land and fresh-water shells, taken by Mr. Lionel E. Adams, was read.

FALMOUTH NATURALIST SOCIETY.—The annual conversazione in connection with this Society was held in the Town Hall, Falmouth, on Monday, October 29th.

KIDDERMINSTER.—Sir R. S. Ball delivered a lecture on "Comets and Shooting Stars," in the Town Hall, on October 29th.

AUSTRALIAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

WE abstract from the columns of the *Sydney Morning Herald* the following report of the proceedings :—

SECTION A.—ASTRONOMY, MATHEMATICS, PHYSICS, AND MECHANICS.

In this section Mr. R. L. J. ELLERY, F.R.S., F.R.A.S., presided, and delivered the presidential address on *The Present Position of Astronomical Knowledge*. After a very exhaustive review of the solar system and the wonders of the universe, he said,—"Owing to the nearness to which the planet Mars often approaches us, and to the earth-like character of its telescope appearance, it naturally presents a most interesting study to the astronomer. It is seen to be marked out as if in continents and seas, the marking often appearing as if obscured by clouds. Very considerable changes in the features have been observed from time to time, and recently appearances as of narrow channels or canals have been seen, which have changed and split, and been joined by cross-channels. These observations have been dilated upon by popular scientific writers, who have suggested that the canals and channels are the work of martial inhabitants for irrigation or other great engineering purposes. The writers must have imagined stupendous works by stupendous beings, when canals and irrigation channels are as wide as the Mediterranean Sea. The mapping of Mars has been pushed to a minuteness that many astronomers cannot follow, but the soaring imagination of one popular writer brooks no bounds, and where we have canals and artificial channels this year we may discover barges and steamboats next. My own experience leads me to regard many of the drawings and speculations concerning the martial surface as being a little in advance of ascertained facts. It is undoubtedly very earthlike in character, and it is very probably nearer the same stage (as regards cooling) of our planet than any other. It also appears to be endowed with an atmosphere often cloud-laden, obscuring the features of the planet's surface. We wait for increased powers of observation at the future near approaches of this planet for further developments. The most interesting fact in connection with this planet is the comparatively recent discovery by Hall, in 1877, in America, of his two satellites, whose existence had not hitherto been even suspected. The remarkable features of these bodies are their nearness to the parent planet, their smallness, and their rapid motion. They have been named Deimos and Phobos (fear and panic). Phobos is only 3,760 miles, and Deimos 12,500 miles, from Mars' surface. The former goes round the planet in a little over seven hours and a-half, and latter in about thirty hours and a-quarter. The actual dimensions can only be estimated from light measures, which give diameters of about nine and eleven miles. Some very important suggestions by Mr. Norman Lockyer, upon the classification of heavenly bodies, and I may almost say a new theory of the universe, have been laid before the scientific public through the Royal Society of London. In brief, it may be stated as follows—Space is a *plenum* of meteoric matter. All self-luminous bodies in the celestial spaces are composed of meteorites or meteoric vapour produced by heat from condensation of meteor swarms due to gravity. He assumes some at least of the meteoric matter to have orbital motion. Some may be in motion, some at rest, but all visible evidence of this matter appears as stars, comets, or nebulæ, between which no distinction can be made on physical grounds. Visibility is brought about by collisions of meteoric particles, and according to the profusion or sparseness of the meteoric particles in space where collisions occur by intersection of orbits with matter at rest, or with bodies in other orbits, we have nebulæ of the several kinds, comets, nebulous stars, and even concrete stars themselves. This may be called the meteoric hypothesis, and as the conception has for its foundation a mass of indisputable facts, the result of long and laborious research with the spectroscope in the laboratory, compared skilfully and patiently with facts, revealed by spectroscopic examination of all classes of celestial objects, I can but regard it as a most important step in physical astronomy, destined, I believe, to mark a new epoch in the science. The idea that meteoric matter or bodies pervade all space is not in itself a new one, for when we consider, accepting Professor Newton's estimate that twenty million meteorites fall to our earth daily, it is evident that space is, astronomically speaking, full of them. Nevertheless, by the same calculation by which Professor Newton arrived at the foregoing number, he ascertained their sparseness to be such that the meteorites must be 250 miles from each other in space. As regards the effects of collision of meteorites, the speed of visible meteors can be measured, and it is reckoned to be at an average thirty miles a second. If then the specific heat of the material of which they are composed be ·10, the increase of temperature when their motion was arrested by a full collision would amount to 2,700,000 degrees centigrade, steel being fluid at 2552° Fahrenheit."

Mr. W. SUTHERLAND read a paper on *The Law of Molecular Force*, and in this paper he further discussed the hypothesis already discussed in the *Philosophical Magazine*, viz. :—That molecular bodies attract one another with a force varying inversely with the fourth power of the distance between them.

He also read a paper on *Molecular Refraction*. This paper was devoted to the question of showing that the formula of the English physicist Gladstone for the connection between the index and the density is the best formula yet proposed, and it had a theoretical foundation.

Mr. H. C. RUSSELL read a paper on *Contributions to the History of Astronomy in Australia*. The paper was a long and exhaustive research into the records of the past, and gave facts and figures relating to the astronomy and meteorology of the early observers. He also read a paper on *A Proposed Method of Recording Variations in the Direction of the Vertical.*

Professor THRELFALL read a letter which had been received from Professor Rucker in relation to the effect rocks containing iron had upon the magnet.

Some discussion took place, which was closed by Professor Threlfall remarking that he did not consider the subject of very great importance, as people did not "steer" by the compass when on land.

Mr. GRAYDON read a paper on *The Diurnal Variation of Atmospheric Pressure and Wind.*

Professor THRELFALL also read papers on *The Measurements of High Resistances, and on Galvanometers Suitable for the Purpose. McArthur Pollock on the Clark Cell as a Means of Obtaining Standard Currents, and on its Application to the Construction of a Graded Galvanometer for the Prince Alfred Hospital.*

SECTION B.—CHEMISTRY AND MINERALOGY.

This section met under the presidency of Professor Black, who delivered the presidential address dealing with general chemistry in relation to education, and contended that chemical knowledge should be taught in all branches of education, especially in the higher schools. In this respect a great improvement might be made from a practical point of view.

The first paper read was on *Butterine as an Article of Food,* by Mr. CHARLES A. SMITH, F.I.C., F.C.S. An interesting discussion followed, in which the president, secretary, and Mr. Pond took part.

Mr. JOHN MINGAYE, F.C.S., assayer to the Mines Department, read a paper on *Discovery of Tellurium in New South Wales, in certain Bismuth Ores, found near Captain's Flat.*

Mr. POND announced the fact that he had found tellurium in New Zealand in the year 1885, in silver ores, through the suggestion of Sir James Hector, in examining some minerals. He thought that Mr. Mingaye had omitted to note the date of the discovery.

Dr. LEIBIUS suggested that a paper on Mr. Pond's research would be valuable, and this was promised for a future meeting.

Mr. HAMLET read a paper, in the absence of the author, by Mr. EDGAR HALL, F.C.S., of the Sunny Corner Silver Mine, on *Silver Smelting, Rich Silver Mattes, and their Treatment, and on Kernel Roasting.*

Mr. POND, in discussing the paper, said that if the section had done nothing more than produce this one paper it had done valuable work. He thought the matter was so important and the treatment so original that it ought to be published in the proceedings. A lengthy discussion followed, in which the secretary, Dr. Rennie, Dr. Leibius, and the president took part.

Mr. W. A. DIXSON read a paper on *Some Considerations in regard to the Formation of Coal.* He said that the examination of some coal from New Zealand and the other colonies had led him to the conclusion that the chief differences in coals were due to the original formation of the vegetable of which they were composed. The best *ligno-cellulose* was largely composed, originally, of resin from vegetation, and cannel coal, appeared to be derived from *adipo-cellulose* mixed with *ligno-cellulose.*

A paper was also read by Mr. HAMLETT, for Mr. F. Ratte, on *Some Means of Popularising the Study of Crystallography.*

Other papers read were :—On *The Occurrence of Silver in the Lodes of the Cape Colville Peninsula, Thames, No. 2,* by Mr. Pond, Government Analyst, Auckland, New Zealand. *On the Dissolved Matter contained in Rain Water collected at Lincoln, New Zealand,* by Mr. George Gray, F.G.S. *On the Origin of Vein-Gold and the Growth of Nuggets,* by Professor Black. *A Contribution to the Solution of the Problem—How Gold came into the Reefs?* by Mr. J. R. Don, M.A. (1) *Notes on the Proposed Chemical Laboratory, University of Sydney,* (2) *Notes on Some New South Wales Minerals,* (3), *Notes on Moss Gold,* by Professor Liversidge, M.A., F.R.S. *Gold, its Formation in our Reefs, with Notes of some of its Newly-Discovered Reactions,* by Mr. W. Skey. *Notes on the Composition of New South Wales Fahlerz and Embolite,* by Dr. G. S. Mackenzie. *Bibliography of the Chemistry of Indigenous Australian Vegetable Products,* by Mr. J. H. Maiden, F.L.S , F.G.S. ; *On the Action of Nepean Water on Tubes and Boiler Plates,* by Mr. Hamlet.

SECTION C.—GEOLOGY AND PALÆONTOLOGY.

The President, Mr. JACK, F.G.S., delivered his presidential address on *Some Salient Features in the Geology of Queensland.* He said that it seemed to him that some vague term, such as "Devonian," would best express the present state of their knowledge of a great part of the region hitherto regarded as "paleozoic." Their knowledge was extremely fragmentary, for it had been shown that formations of widely different dates may, under similar conditions of disturbance and pressure, assume the same lithological characteristics; one portion, for instance, may be a goldfield and another part a coalfield. He thought they would have to look for help in unravelling the structure of Queensland to the workers in other lands and to such meetings as the present.

Mr. S. H. COX, F.C.S., F.G.S., read a paper on *The Development of Mining in Australasia.* He said that as regards gold, by far the greater returns had been obtained from alluvial deposits. In early days, when alluvial gold was easily got, the deposits in some cases were surprisingly rich. The large returns in Victoria during the period from 1852 to 1862 were of gold almost exclusively alluvial. In those days men squandered their money in a reckless manner. There was one instance on record of a man having his horses shod with gold when a successful member of Parliament was brought into the town. The same individual was reported to have spent £200 in drink for the men every time he visited the claim. The copper ores, which had hitherto been worked in Australia, appear to have been always associated with rocks of the Silurian age. From a productive point of view, the collieries were no doubt steadier-paying mines than the metalliferous ones, although there were no sensational returns; nor was the value of the coal raised so high as would be anticipated by the stress which is frequently laid upon the value of the coal-mining industry. Australia was essentially a mining country, and was a place where all classes of ores are to be found. It was a country which offered every inducement for the further development of its resources. There was no doubt that they had every source of wealth, but the future of Australia was very largely dependent on the minerals raised. There was, perhaps, no part of the world where the valuable ores are so evenly distributed throughout the ground, but the success of the mining industry would greatly depend upon the skill that is brought to bear upon the extraction of the mineral and the treatment of the ores.

Mr. A. W. HOWITT read a paper on the *Metamorphic Rocks of Gippsland.* His deductions were to the effect that the rocks referred to were clearly connected with the vast earth movements which occurred at the close of the Silurian age.

The Rev. J. E. TENISON-WOODS read a paper on the *Desert Sandstone of Australia.* He said that the term "Desert sandstone" had been loosely applied in Australasia. He considered that the whole formation belonged to the tertiary period, but differed much in point of age.

Mr. T. W. EDGEWORTH DAVID read a paper on the *Origin of the Laterite in the Vegetable Creek District of New South Wales.* He said that the term "laterite," as used, is defined as a rock consisting of silicate of alumina and peroxide of iron. The colour is of a prevailing brick red, passing into ocherous, and the rock shows every gradation from a soft ferruginous clay, resembling lithomarge, to a hard pisolitic ironstone. Laterite is found in New South Wales, associated with the basalts and auriferous and stanniferous gravels of the tertiary age. Mr. C. S. Wilkinson has described this rock as "a sandy concretionary ironstone, which sometimes assumes a pisolitic structure." At Emmaville, in the Vegetable Creek district, the laterite has a thickness of from a few feet to 40 ft., and occurs in oval patches from half-a-mile to two miles wide, situated chiefly at the sources of the lava sheets, and forming the material of which a number of small basaltic craters are composed. Some of these craters retain so much of their original shape as to leave no doubt as to their true nature, while others have suffered so much from denudation as to preserve no vestige of their original crater rings. In two places at Vegetable Creek cavernous spaces 2½ ft. high and several chains wide were found to separate the under surface of the laterite from the underlying decomposed basalt. These are compared to the lava caves at Laurel Hill, near Tumberumba, New South Wales, and to those described by Darwin in islands of the Galapagos Archipelago. The conclusion is that the greater part of the laterite is an altered basalt tuff belonging to the earlier basalt eruptions, of Eocene age, or possibly to a time intermediate between that of the older and newer basalts. That water has played an important part in altering the tuffs, and possibly in redistributing them is proved by the occurrence, though exceptional, of small fragments of plants intermixed with the laterite, and of lenticular beds of limonite occupying local depressions on its surface.

Papers were also read by Professor Tate, on the *Secondary Rocks of Lake Eyre Basin, The Census of the Older Tertiary Fauna of Australia,* and *Glacial Phenomena in South Australia ;* by Mr. H. T. L. Brown, on the *Mesozoic Plains of South Australia ;* by Professor Hutton, *On the Rocks of the Thames Goldfields, U.L. ;* by Mr. F. W. Edgeworth David, B.A., F.R.G.S., on *Micropetographical Notes on some of the Hydrothermal Rocks of New South Wales,* and *On the Copper Shales of the Passage Beds between the Hawkesbury Series and the Upper Coal Measures of New South Wales ;* by Mr. H. T. Wilkinson, J.P., on *The Geology and Physical Geography of Norfolk Island;* by Mr. T. Mitchell, on *The Geological Sequence of the Bowring Beds.* Other papers were read on *On the Advisability of Establishing a Mining Institute in New South Wales, especially from a Geological Point of View,* by Mr. F. Ratte ; *On the Discovery of Fossils at Rockhampton,* by Mr. James Smith, F.G.S. ; *How Far can Australian Geologists safely Rely upon the Order of Succession of the Characteristic Genera of Fossil Plants of a far Distant Region, in the Determination of the Order and Relationship of Australian Terrestrial Formations?* by Mr. R. M. Johnson, F.L.S. ; *On Certain Boulders met with in the Beds and Reefs of the Gympie Goldfield,* by Mr. W. H. Rands ; and *On Metamorphism, and the Rocks of the Bathurst District,* by Mr. W. J. Clunies Ross, B.Sc.

SECTION D.—BIOLOGY.

The President, Professor RALPH TATE, F.G.S., delivered the presidential address, taking for his subject *The Influence of Physiographic Changes on the Distribution of Life in Australia.* The address consisted of an account of the influence of certain changes in the conformation of the land, and the distribution of land and water with concomitant and resultant changes of climate which have probably taken place in the later geological periods on the distribution of life, both plant and animal, on the surface of the continent. He traced more particularly the distribution of the flora over the various regions, and sought to account for its present peculiarities by reference to such changes in the level of the land and the like as seem to have taken place since the Cretaceous period. He pointed out the fallacy of the idea popularly entertained that there was evidence of the existence in Tertiary times of an extension of the sea through Central Australia, the Tertiary beds of that region bearing evidence that they were not of marine but of lacustrine origin, containing remains of fresh or brackish water or land animals, but of no marine forms. He showed that this region was, at the time when other parts further south were subjected to the action of glaciers, a region of great rainfall and consequent formation of great valleys and great accumulations of fluvialite deposits. He followed out the effects of these conditions and of various oscillations of climate which Australia had undergone in more recent periods in determining the leading peculiarities in the geographical distribution.

The first paper read was one by Mr. W. M. HAMLET, F.I.C., F.C.S., *On the Action of Metallic Salts in the Development of Aspergillis nigrescens*. Certain samples of bread submitted to Mr. Hamlet for analysis were found to be densely crowded with the hyphae and conidia of a mould-fungus—*Aspergillus nigrescens*—and, on analysis, a small quantity of zinc was found in the bread, to the presence of which, probably derived from galvanised iron tubs or vessels used in the baking, the specially active growth of the mould was ascribed.

Dr. JOSEPH BANCROFT, of Brisbane, read a paper and gave a demonstration of the respiration in the roots of shore plants that inhabit the undrained mud-banks of the coast of Queensland. It appears there is a remarkable organ that springs up from the roots of avicennias covered with circular pores. The pores throw off flakes of white corky cells. This action of the plant opens up air communication with the pithy roots, that live permanently in fœtid mud. These organs he calls "breathers." They are 18 in. high in Avicennia and in Sonneratia, brought from the Johnson River by Dr. Tom Bancroft, are upwards of 6 ft. in length, and 6 in. in diameter, tapering to a point. The breathers never throw out leaves, but when wounded will become forked. In Brugueira, another shore plant, knees are thrown up on which lenticels are developed. Mangroves show lenticels on their many-legged stems. The Swamp cypress of the Southern States of America throws up knees which are cut off and used for buckets. Dr. Bancroft believes the function of the cypress knees will be found analogous. Roots of the shore plants were immersed in water, and on air being forced through them, it appeared in bubbles at all the lenticular apertures. Dr. Bancroft is of opinion that gardeners will profit by the understanding of the value of these lenticels being kept clean and free from lichenous growth on the stems of their fruit-trees.

A lengthened discussion, in which Mr. Tyron, of Brisbane, Professor Baldwin Spencer, Professor Anderson Stuart, and the President took part, then followed on the nature of these lenticular openings and the office they performed in the economy of the plant.

Papers were read by Mr. Arthur Dendy, M.Sc., F.L.S., bearing the following titles: *Preliminary Notes on the Structure and Development of a Honey Sponge* (Stelospongus flabelliformis); *On the Minute Anatomy of an Australian Land Planarian.* Papers were also communicated by Mr. W. J. M'Kay, B.Sc., on *The Development of the Pineal Eye in some Australian Lizards;* by Mr. A. Fletcher, B.Sc., *On a Myxosporidium infesting Australian Frogs;* by Mr. W. A. Haswell, M.A., D.Sc., *On the Striated Muscular Fibres in nvertebrates and in the Muscular Tissue of Peripatus.*

SECTION E.—GEOGRAPHY.

The section met under the presidency of the Hon. John Forrest, C.M.G., Commissioner for Crown Lands of Western Australia. The President did not consider it advisable on this occasion to confine his remarks to a particular geographical subject, as is usual in old-established societies, as he thought a few general observations on subjects within the wide scope of the geographical section of the Association would be more useful on the present occasion. He proceeded to remark on the territorial divisions of Australia, and made a graceful allusion to the work of explorers who have passed away. He made a plea for the systematic teaching of Australian exploration in our schools, and what more useful work would there be than teaching the rising generation the way in which the Continent we live in and love so well has gradually been opened up to the enterprise and commerce of the world. After briefly, but eloquently, describing the changes which civilisation has wrought in Australia within the space of the past 100 years, the question might arise in our minds as to what Australia would be like in another century, and that such thoughts should stimulate us to great exertions. The old way of travelling by cart and coach has given way to the railway, and the old way of shepherding our stock is fast disappearing; in fact, our present ways are not the old ways; and so it must be with the work of exploration. The old way must be superseded by the new; no longer must it be the love of adventure, and the fascination of discovering new mountains and new rivers, but our aim must be to examine and map the treasures of the earth. The man of science must now with care and with skill, and with slow but sure steps, follow on the steps of the early geographical traveller, and the prosecution and accomplishment of this great work be commended to the Governments and people of Australasia. As a rule, expeditions have been badly provided, have received but scant encouragement, and have had but small Government support. It therefore has frequently happened that fertile tracts of country have remained unknown and unutilised for years, just because a Government has not had sufficient knowledge and enterprise to have it examined and reported upon. As far as pastoral pursuits are concerned, the enterprise of the squatter has done good and lasting work. The question of federation must also occupy attention. At present the people of Australia were in many respects as foreign people to one another.

Papers were also read by Mr. James Stirling on the *Physiography of the Australian Alps*; by Sir Edward Strickland on *Emin Bey;* by Mr. H. G. M'Kinney, M.E., on *The Rivers of New South Wales;* by Mr. James Panton, P.M., on *Supposed Further Traces of Leichhardt;* by Mr. G. S. Griffiths, F.G.S., F.R.G.S., on *Antarctic Exploration the Duty of Australasia;* and by Sir Edward Strickland, K.C.B., F.R G.S., *Epitome of the State of our Geographical Knowledge of Australasia.*

SECTION G.—ANTHROPOLOGY.

Dr. A. CARROLL delivered his presidential address on the *Movements of Races from Asia to America and Australia.* The paper dealt with the little progress hitherto made in the progress of anthropology in Australasia or the Pacific since the entrance of the Spaniards to these regions; how little true advancement has been made in the study of the Pacific islanders in comparison with the peoples of other regions, and their ancient history, especially the Egyptians, Babylonians, etc.; the movements in High Asia 4,000 years ago of the various races and mixed peoples; the reactions of these upon the Davidians, the "Kush," and the various Babylonian colonisers and Syrian peoples, and the obliteration of the "Kush," who were afterwards absorbed by the "Shemites," etc.; the earlier natives of China—the "Mon," the "Lo," the "Yun," the "King," the "Mao"—some of whom were long before this immigration civilised nations; the quarrels of the Aryans, their separation, their advance towards India and to Media, Persia, etc.; the introduction of their dialects, myths, poetry, hymns (as the "Rig" and other "Vedas"), their native worship and their sun, etc.; myths and the families of these; and the history of the races of the world to the present era.

Mr. J. J. WILD read a paper on *The Outline of Anthropological Science,* which he explained was a new science developed by the intense intellectual activity of the 19th century. It was the science of man, and had led to a series of most surprising discoveries of the pre-historic race. The instruments of discovery had been the pick and the spade in turning over the soil of Italy, Greece, Syria, and Egypt. In all the terrible catastrophes which had overwhelmed man he had always come forward in a higher type of humanity and rising toward the higher destiny.

The Rev. G. PRATT read a paper on *The Genealogy of the Sun and an Ancient Samoan Legend,* which described the intercourse between the inhabitants of heaven and earth, and related the uplifting of the sky.

Among the other papers were: *A Comparative View of the Customs of the Papuan and Malay Races of Polynesia,* Rev. S. Ella; *Some Niceties of Expression in the Languages of the New Hebrides,* Rev. J. Copeland, M.A.; *Maori Art,* Mr. A. Hamilton; *Notes on the Last of the Tasmanian Aborigines,* Hon. Dr. Agnew.

SECTION H.—SANITARY SCIENCE AND HYGIENE.

Dr. BANCROFT, of Brisbane, delivered the presidential address, choosing for special reference the various hygienic aspects of Australian life. The many difficulties with which sanitary science had to contend were referred to, especially the slowness of the recognition of its paramount importance. He then adverted to the question of longevity, and pointed out that while these warmer countries are favourable in many respects to long living, the death-rate among children under the age of five was rather startling. He then proceeded to remark upon certain conditions of life which may have influence in the production of such a result. If, he continued, "this high rate of infantile mortality is to be reduced, more care—at least in Queensland—will have to be taken in improving the dwellings." The improvements suggested were in the direction of increased size, and of improvement in the corrugated iron roof by duplication with suitable intermediate packing so as to diminish the extremes of heat and cold, which are permitted by the single roof. Then the planting of trees to moderate the aridity of the air was advocated, and it was pointed out that though sanitary science can do little to mitigate the severity of climate, it ought at least to guide the choice of healthy sites for habitation. The hygienic conditions of country life were next touched upon, and the characteristics of a favourable site were described. The question of milk was next considered, and the value of substitutes referred to. Simple measures for the reduction of the house-fly nuisance attested by the author's experience, were given, as well as for other insect pests. The difficult questions of sewage and nightsoil disposal were also treated of. Dr. Bancroft warmly invited the attention of botanists to the problem of the cultivation of soil fertilised by sewage, when the fertilising agent so greatly exceeds the necessities of the land itself, and he himself indicated some probably valuable lines of cultivation. The vexed question of the mode of dissemination of typhoid came next for attention. The principles laid down may be thus summarised. The European idea of the spread of typhoid, almost entirely by sewage infection of drinking water, comes far short of the facts as we know them here.

SECTION J.—ENGINEERING AND ARCHITECTURE.

This section was presided over by Professor Kerney, of Melbourne. It was opened by a paper on *The Deep Drainage System of Adelaide: Its Results and Mistakes*, by the Hon. Dr. Allan Campbell, M.L.C., Adelaide. The paper elicited a considerable discussion, as the question is one in which the public interest in Sydney and Melbourne at this moment is deeply centered. Professor Warren; Mr. Jones, hydraulic engineer; Hon. Dr. Garran, M.L.C.; Mr. Helmsley, and others, took part in the debate. In the majority of instances the views put forward by the writer were endorsed by the speakers. The suitable situation of Adelaide for economical drainage was pointed out, its previous unsanitary state detailed, and the assertion was made that it is now the cleanest, and has the lowest death-rate of any of the Australian cities. Mortality returns were given to show this. A description, from an engineering point of view, was given of the system, and also a detailed account of the result when the system was first brought into operation. It was here where the writer pointed out the rock on which the system split, and which had led not a few sensible people in Adelaide to declare, in that new country, a great practical blunder had been committed. The ventilation of the street sewers was so imperfect that a greater nuisance appeared to have been created than the one the system was intended to remove. It was pointed out that the use of the "boundary" or "disconnecter" trap divided the system, so far as its ventilation was concerned, into two parts—the one next the street sewers unventilated, the other next the dwelling-houses ventilated by what the writer called the principle of through ventilation. The latter had never given rise to any annoyance, while the former was an unmitigated nuisance. Improvements on this portion of the system had to be made, and the principle of through ventilation partially applied. The result had been so satisfactory that Dr. Campbell claimed that the same principle should be applied throughout, and the only means of doing this was to abandon the use of this "disconnecter" or "boundary" trap. The object of this trap is to bar the way of foul sewer air towards the dwelling-house, but it was shown clearly and comprehensively that barring the way was simply creating a lodgment for foul air. The best thing to do was to make sure that foul air would not be permitted to form, but every instant would be swept out of the way. It was pointed out that the sewers were small in size, they discharged their contents with great ease and rapidity, and they were easily ventilated. It was also shown that no pipe from the inside of any dwelling stood in direct connection with any drain, but the flow from all pipes fell into a receptacle or trap, which had on its drain side a ventilating tube led high above the eaves of the house. By such means no pressure could bear against the water seal of this trap. Join this further fact to what has already been said, that periodical compulsory examinations of all house drains are made with the smoke test, and it was contended that the danger which the "boundary" trap was employed to prevent could not actually exist. It was urged that we ought not to import conceptions derived from a system of sewers such as had been employed in the old country and elsewhere. We must view the new mode of construction scientifically, that is, as it actually stands, losing sight of no factor in the system; and if we did so, the whole was simple and clear on the question of ventilation. In closing an animated debate, Dr. Campbell quoted the opinion of an engineer of some eminence (Julius W. Adams), who advocated the ventilation of a sewerage system on the same lines as he did, that all that was required was to "enable the sewers to breathe and ventilate themselves."

SECTION J.—ARCHITECTURE AND ENGINEERING.

Professor KERNOT introduced the subject of waterways of culverts and bridges. He remarked that the question was one of the highest practical importance to the road and railway engineer. He quoted a considerable number of rules and formulæ proposed by English, American, Indian, and Victorian engineers, and gave his preference to a modification of Colonel Dickens's rule. He showed that the proposed rule corresponded fairly well with a large number of successful structures of long standing in New South Wales and Victoria, and that the proportions that departed farthest from it on the side of efficiency had coincided with the scenes of disastrous failure and costly reconstruction. These cases were:—1. Bridgewater, Tasmania, 13 square feet waterway to 2 1-3rd square miles drainage area. 2. Bendigo Creek, Sandhurst, Victoria, 190 square feet to 16 square miles. 3 Cootamundra, New South Wales, 53 square feet to 20 square miles. 4. Plenty River, Victoria, 440 square feet to 60 square miles. 5. Barwon River, Geelong, Victoria, 4,000 square feet to 1,700 square miles. The rule given by Professor Kernot required for the Bridgewater case about 110 square feet instead of 13, for the Bendigo Creek rather over 300 instead of 190, for Cootamundra 380 instead of 53, for Plenty River 860 instead of 440, and for the Barwon 10,000 instead of 4,000. On the other hand, it agreed fairly well with numerous important bridges over the Bendigo Creek, Moonee Ponds, Yarra, Saltwater River, and Barwon in Victoria, that have been often tested by heavy floods during the past 30 years, and have proved sufficient but not excessive; and also with the bridges at Bathurst and Wellington in New South Wales. The paper was illustrated by large diagrams, and the author concluded by requesting the members to send him particulars of any cases of sufficient but not excessive waterways of old standing, also cases of notable failure, whereby further to confirm or, if necessary, slightly modify the rule proposed by him.

Mr. C. O. BURGE read a paper on the *Recent Progress in Sinking Deep Foundations for Engineering Work*—in the first place, with the partial substitution of iron for timber in pile work; several instances were given of the use of screw piles on a large scale, and of the failure of them in many cases where they had not been used with sufficient judgment. Their suitability for marine piers and other similar structures was alluded to, and examples quoted. Cylindrical foundations were noted, both of brick wells, of which the use in India is universal, not only largely in the present day for great railway bridges, but in ancient times by natives; and of iron cylinders, which, out of India, are the most favoured methods of construction for works of the kind. Several bridges in India, the new Tay bridge, double cylinders at the Cape and elsewhere, were alluded to in this connection, and the alternative of several small brick-wells or few larger ones was adverted to, as forming a subject of professional differences of opinion in India. After describing a curious operation witnessed by the author at Cawnpore, in destroying old well foundations to make room for new ones, the paper proceeded to the consideration of the pneumatic methods, both in cylinders and in caissons. The St. Louis, Brooklyn, Forth, and Harlem bridges, and one at Copenhagen, were briefly described as regards their substructure, as well as the Eiffel tower in Paris, and the Delaware Bay lighthouse, the latter, from its exposed position, being a work of unexampled difficulty, all these having been founded by means of the pneumatic process, but differing in detail; these, of course, being merely prominent instances of a system widely adopted, especially on the Continent of Europe and in the United States. Beyond the depth of about 100 ft. below water level, which is the limit of the scope of the pneumatic process, mechanical dredgers have to be used, and as the skin friction becomes in these cases so great that the weight of the cylinder itself, even if reinforced by all practicable temporary loading, is insufficient to sink it, the design must be made so that the caisson, or cylinder, must carry its own weight by loaded concrete partitions.

A paper *On Utilising Waste Underground Waters by Tunnelling in the Hills*, by Mr. T. Parker, C.E., of Adelaide, was next read. The author described the loss of water by evaporation, absorption, and percolation, and suggested tunnelling to catch the latter, especially in connection with the Adelaide water supply, the advantages being extra purity of water, economy, no reservoirs being required, and facility of extension. Professor Kernot remarked on the great waste of water, only 1 per cent. of the rainfall reaching the sea from the western rivers.

CORRESPONDENCE.

The Editor does not hold himself responsible for opinions expressed by his correspondents, nor can he take notice of anonymous communications. All letters must be accompanied by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

THE SPARROW AGAIN.

Beginning at the end of the very positive letter of your correspondent, Mr. J. P. Nunn, I must inform him that I used the word "swallow" generically for the entire genus *Hirundo*. Their taking possession of a martin's nest is of such constant occurrence that I have known the latter birds to be positively driven away from a gentleman's mansion in Essex, in spite of all efforts for their protection. Their persecution of the true insectivorous birds is a sad reality. A correspondent of the *American Naturalist* describes the repeated raids which they made upon a wren's nest in his garden, and how he was obliged to protect the nest with a cover having a hole too small for the sparrow to enter. Now, as the wren is one of our most diligent insect-eating birds, this is a case in point. Further observations, alike in America and Europe, go to show that in proportion as the sparrow multiplies in any district other small birds become scarcer.

The suggestion that I "cannot know what kind of bird the American robin is," is very wide of the mark. I knew it forty years ago. But the comparative size of the birds is quite beside the question. If on opening the crops of two birds we find that of the one mainly filled with insects and that of the other with grain and fruits, we know at once that the former is a friend to the farmer and gardener, and the latter an enemy.

I am perfectly aware that the swallows do not feed on grubs and caterpillars. But I would invert Mr. Nunn's exclamation, and say, "If the flies and the moths are to be allowed to live and deposit their eggs that these may turn into food for sparrows, woe to all our fruits and flowers!" Sparrows, thinks Mr. Nunn, "congregate where they can obtain food." So do other birds. His examination of the nests of eighty-nine pairs of sparrows proves nothing, unless he can also show how many broods a pair of sparrows may have in a year (whilst many other species have one only), and how many nests there are, say, per square mile, and then make a comparative census of the small birds in the same manner. Until he has done this he has proved nothing.

The observations of S. A. Forbes are perfectly conclusive, at least for the district where they were made. Let Mr. Nunn shoot a few of his clients, and make an examination of the contents of their stomachs, and he will, I believe, find himself compelled to throw up his brief. ARUSPEX.

THE COCHINEAL INSECT.

The writer of the article on "Cochineal Insects" (SCIENTIFIC NEWS, p. 459) can scarcely be aware that the dye obtained from these insects, once so valuable, is rapidly falling into disuse, being to a great extent superseded by the azo-scarlets obtained from coal-tar. In consequence, many of the *Coccus* gardens are being turned to other uses.

The "green dye" obtained from caterpillars has been proved by Mr. Poulton and others to be identical with the chlorophyll or leaf-green of plants, and if required for use in the arts can be much more readily obtained from grass than from spinach. A TINCTORIAL CHEMIST.

DRAGON-FLIES.

Will you allow me to inform your numerous readers interested in entomology, that I shall be very pleased to assist any one desiring to commence the study of dragon-flies (*Odonata*). I shall also be glad to name and identify any specimens of these grand insects which may be sent to me.

Birmingham. W. HARCOURT BATH.

ANSWERS TO CORRESPONDENTS.

TEIGNMOUTH. — The subject of your communication was dealt with on page 193 of vol. i. of the SCIENTIFIC NEWS. We would direct your attention to the rules at the head of this column.

RECENT INVENTIONS.

The following list has been compiled especially for the SCIENTIFIC NEWS *by Messrs.* W. P. THOMPSON *and* BOULT, *Patent Agents, of* 234, *High Holborn, London, W.C.; Newcastle Chambers, Angel Row, Nottingham; Ducie Buildings, Bank Street, Manchester; and* 6, *Lord Street, Liverpool.*

PROPELLER FOR VESSELS.—Mr. R. Morris has patented a means for propelling vessels, torpedoes, etc., by compressed air. A cylinder is provided and fitted with a plunger, piston rod, and an air valve at each end. When the plunger is put in motion air is taken into the cylinder through the valve at one end and is forced out through the other valve into a pipe which passes through the exterior of the vessel to the water outside. The compressed air is thus forced against the water and sufficient force obtained to propel the vessel.

GALVANIC BATTERIES.—Mr. P. Skrivanow has patented a galvanic battery. This battery consists of an electrode of iron, and a plate of retort charcoal. Over the latter is spread a layer of peroxide of lead, and the whole is enveloped in a sheet of parchment paper retained by rubber bands. The two electrodes are placed in a solution of hydrate of potassium. A dry battery can be obtained by covering the positive electrode with several sheets of filtering paper soaked in the above solution, and applying above it the negative electrode.

MARINE ENGINES.—Mr. J. McGregor has patented a compound marine steam-engine so that the steam may be expanded through three successive stages with a satisfactory distribution of the various strains. To carry out the invention four cylinders are used in each instance, connected by pairs to two cranks on the same crank shaft. In a modification two high-pressure cylinders are geared to and work at the back of an intermediate and a low-pressure cylinder, the valves of the high pressure cylinders being actuated by an extension of the valve rods of the two larger cylinders.

ELECTRIC SHOCKS.—Messrs. J. Douglas and H. Abbott have patented an apparatus for producing and administering electric shocks. A case is provided containing a tray for carrying the battery, suspended by cords from a cross-bar fixed to two telescopic tubes which form handles outside the case. The pulling out of the tubes over their cores carries the cross-bar with them, and at the same time the tray and battery are lifted. The cross-bar carries a bracket to which the core of a magnet is fixed, so that as the handles are drawn out the current is increased. The weight of the tray and battery takes back the handles when released.

WATCH.—An improved watch or chronograph has been patented by Messrs. H. and C. Turler, of Bienne, Switzerland, the object of which is to enable the wearer to ascertain any space of time which has elapsed during a given period. In addition to the ordinary hands, the watch has three smaller supplementary dials, each provided with mechanism which is thrown into operation when desired, and on which are recorded the hours, minutes, and seconds respectively which have elapsed during the time it is desired to measure. When the special dials are not required, the mechanism is thrown out of action, and the watch is similar to an ordinary one.

ELECTRO MOTORS.—Mr. M. Immisch has patented an improvement in the construction of the cores of armatures of electro motors and dynamo machines. It consists in the employment of collars, keyed to an armature spindle. One of these collars is capable of longitudinal movement thereon, while both collars are formed with grooves the bottoms of which are inclined. These grooves receive keys having correspondingly inclined surfaces, so that the longitudinal movement of one of the collars will cause the keys to move outwards, and by acting upon the plates or wire of which the armature is built up, will firmly hold and tighten same, while exerting a yielding or elastic pressure thereon.

FIREARMS.—Mr. H. S. Maxim has patented means for pointing fire-arms. The object is to enable a gun to be elevated and sighted accurately without previously ascertaining the distance between the gun and the object aimed at. It is based upon the fact that the greater the distance of an object from a given point the less will be the angle at this point subtended by the object. It is carried into practice by providing a sight of two pieces arranged so as to be simultaneously adjusted toward or from each other, that is to say, assuming these adjustable pieces to be arranged in the back sight, the said pieces will be moved towards each other simultaneously with the raising of the sight and away from each other by the lowering thereof. The fore-sight is formed with a hole and two pins extending horizontally from opposite sides of the eye to its centre.

MARINER'S COMPASS.—Mr. J. C. Dobbie, of Glasgow, has patented improvements relating to the mariner's compass, comprising means for the suspension of the compass bowl and for the taking of azimuth bearings. The bowl of the compass is suspended by means of a link or chain from a metallic spring fastened vertically to the interior of the binnacle casing, or the springs may be horizontal and the gimbal ring provided with bearings which fit in or upon sockets formed on the before-mentioned springs. For taking azimuth bearings, a reflecting mirror is fixed on the case. This mirror is formed of two parts, hinged, or otherwise adjustable, so that one serves to reflect the object whose bearing is to be taken, and the other the reading of the compass-card. In use the mirrors are adjusted by hand to the requisite position, and the reading of the card is facilitated by the two mirrors.

GALVANOMETERS.—Messrs. W. E. Ayrton and J. Perry have patented a galvanometer. The invention relates to galvanometers of the siphon recorder type, whether used as measuring instruments or as telegraphic receivers. In order to prevent the sensibility of the instrument being altered by either a temporary or permanent variation of the strength of the magnetic field in which the movable coil is suspended, one or more small permanent magnets are attached to the movable coil with their magnetic axes parallel to the plane of the latter; the moment of the controlling couple and that of the deflecting couple then alter in the same ratio with any alteration in the strength of the field. When the zero is altered, for example, by bringing the instrument near a dynamo, the magnet or coils which produce the magnetic field are turned about an axis, passing through the axis of suspension of the movable coil into the proper position. The connections with the suspended coil may be made by means of mercury cups, or preferably by fine wire spirals.

ANNOUNCEMENTS.

CAMBRIDGE.—At St. John's College the following scholarships and open exhibitions are offered for competition to persons not yet in residence:—1. Foundation scholarships, two of the annual value of £80, two of £60, and two of £50, tenable for two years, and the tenure may be prolonged for two years more. 2. Minor scholarships, four of the annual value of £50 tenable for two years, or until the holder is elected to a foundation scholarship. 3. Exhibitions varying in number and value according to the merits of the candidates and the number of vacancies at the time of the election. Candidates for scholarships must be under nineteen years of age, but this restriction does not apply to candidates for exhibitions. Besides scholars and exhibitioners, a certain number of sizars may be elected according with the results of the examination. Candidates may present themselves for examination in classics, mathematics, natural sciences, Hebrew, and Sanskrit. The examination in classics and natural science will commence on Tuesday, December 11th; in mathematics and Hebrew on Thursday, December 13th. Candidates in Sanskrit must give a month's notice of their intention to present themselves for examination. The name of every candidate with certificate of birth and character should be sent not later than December 1st to the tutor under whom it is proposed to place him. Names will be received by any one of the tutors, Dr. Sandys, Rev. E. Hill, Mr. W. E. Heitland, and Rev. J. T. Ward.

LONDON INSTITUTION.—The following lectures will be delivered on Mondays and Thursdays, commencing Nov. 19th:—"Time and Tide—the Romance of Modern Science," Sir R. S. Ball, F.R.S.; "Electrical Transmission of Power," Prof. W. E. Ayrton, F.R.S.; "Time and Tide—the Romance of Modern Science," Sir R. S. Ball, F.R.S.; "Handel—Vocal, Instrumental, and Pictorial Illustrations," William H. Cummings, Esq.; "The Colours of Polarised Light," Prof. Thompson, D.Sc., B.A.; "Political Progress in the Seventeenth Century," Prof. Samuel Rawson Gardiner, LL.D.; "The Colours of Polarised Light—Part II.," Prof. Sylvanus Thompson, D.Sc., B.A.; "Life History of Some Plants," Prof. Charles Stewart; "The New Forces in India," Sir W. Wilson Hunter, K.C.S.I., C.I.E., LL.D.; "Life History of Some Animals," Prof. Charles Stewart; "The Story of a Tinder Box," with Experiments (Christmas Course for Juveniles), Dr. Meymott Tidy, F.C.S.; "Art and Artists," with illustrations, Harry Furniss, Esq.; "Pigmies," Prof. Flower, C.B., LL.D., F.R.S.; "Recent Babylonian Explorations," W. St. Chad Boscawen, Esq.; "The English Novel in the Seventeenth Century," Edmund Gosse, Esq., M.A.; "Astronomical Photography," A. A. Common, Esq., F.R.S.; "The Times of the Twelve Cæsars," Rev. Canon Benham, B.D.;" "Modern Wit," Armytage Bakewell, Esq.; "The Times of the Twelve Apostles," Rev. Canon Benham, B.D.; "Cædmon—Our First Poet in the Island of England," Rev. Stopford Brooke, M.A.; "Men, Women, and Artists," Harry Quilter, Esq., M.A.; "Some Curiosities of Magnetism," Shelford Bidewell, Esq.; "Darwin versus Lamarck," Prof. Ray Lankester, F.R.S.; "Ants," Rev. J. G. Wood; "The Legend of Beauty, or, Art as Representing the Passion of our Lives," Wyke Bayliss, Esq., F.S.A.; "Recent Studies of Some Forms of Minutest Life," Rev. Dr. Dallinger, F.R.S.; "Modern Composers of Classical Song—I. Franz Liszt, Johannes Brahms, and others," Carl Armbruster, Esq.: "Soap Bubbles, and what may be shown with them," C. V. Boys, Esq.; "Modern Composers of Classical Song—II. Robert Franz," Carl Armbruster, Esq.; "Marriage Laws—Ancient and Modern," E. B. Tylor, Esq., D.C.L., F.R.S.; "Algeria and Morocco," Henry Blackburn, Esq.; 'Our Early British Ancestors," Prof. W. Boyd Dawkins, F.R.S.; "The Phonograph," Col. Gouraud; "The Characters of the Great Composers, and the Characteristics of their Works," Prof. Ernst Pauer. The Christmas Course, by Dr. Meymott Tidy, is intended for juveniles, for whom seats will be specially reserved. Further particulars can be obtained on application to the Secretary of the London Institution, Finsbury Square, E.C.

NOTICES.

The Title Page and Index to Vol. I., now ready, price 3d.

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SELECTED BOOKS.

Human Physiology (a Text-Book of). By Professor L. Landois, of Greifswald. Translated from the sixth German edition, with additions, by Professor Wm. Stirling, M.D., Sc.D., Owens College, Manchester. With 692 illustrations. Third edition. London: C. Griffin and Co. Price 34s.

Nature and Man. Essays, Scientific and Philosophical. By the late W. B. Carpenter, M.D., F.R.S. With an Introductory Memoir by J. Estlin Carpenter, and a Portrait. London: Kegan Paul, Trenoh and Co. Price 8s. 6d.

The Walks Abroad of Two Young Naturalists. From the French of Charles Beaugrand. By David Sharp, M.B., F.L.S., F.Z.S., President of the Entomological Society of London, etc. London: Sampson Low, Marston, Searle, and Rivington (Limited). Price 7s. 6d.

DIARY FOR NEXT WEEK.

Tuesday, Nov. 13.—Gresham College, Basinghall Street, E C., at 6 p.m.—*Music*, by Dr. Henry Wylde.
Institution of Civil Engineers, 25, Great George Street, Westminster, S.W., at 8 p.m.—*Friction-Brake Dynamometers*, by Mr. W. Worby Beaumont, M.Inst.C.E.
Anthropological Institute of Great Britain and Ireland, 3, Hanover Square, W., at 8.30 p.m.—*On a Method of Investigating the Development of Institutions; Applied to Laws of Marriage and Descent*, by Edwd. B. Tylor, Esq., D.C.L., F.R.S.

Wednesday, Nov. 14.—Gresham College, Basinghall Street, E.C., at 6 p.m.—*Music*, by Dr. Henry Wylde.

Thursday, Nov. 15.—Manchester Microscopical Society, 65, King Street, at 7 p.m. — Mounting Section. Demonstrators, Messrs. E. Ward and J. L. W. Miles.
Chemical Society, Burlington House, at 8 p.m.
Gresham College, Basinghall Street, E.C., at 6 p.m.—*Music*, by Dr. Henry Wylde.

Friday, Nov. 16.—Greenock Philosophical Society.—*Poetry: its Nature and Relations to Modern Life and Progress*, by William Jolly, Esq., H.M. Inspector of Schools.
Gresham College, Basinghall Street, E.C., at 6 p.m.—*Music*, by Dr. Henry Wylde.
Institution of Civil Engineers, 25, Great George Street, Westminster, at 7.30 p.m. Students' Meetings.—*Experiments on Beams*, by Mr. Ed. C. de Segundo, Stud.Inst.C.E.

METEOROLOGICAL RETURNS

for the ten weeks ending on Monday, Oct. 29th, 1888. Specially prepared for SCIENTIFIC NEWS from official reports.

	Mean Temperature.	Rainfall.	Duration of Sunshine.
Scotland, East	50·3 degs., being 0·3 degs. below average.	4·0 ins., being 3·5 ins. below average.	237 hrs., being 25 hrs. below average
England, N.E.	50·7 " " 1·5 " " "	3·4 " " 3·0 " " "	338 " " 9 " above "
England, East	51·6 " " 2·9 " " "	3·9 " " 2·3 " " "	312 " " 36 " " "
Midlands ...	50·8 " " 3·1 " " "	3·3 " " 3·8 " " "	283 " " 23 " " "
England, South	53·2 " " 2·2 " " "	4·1 " " 2·7 " " "	322 " " 51 " " "
Scotland, West	50·9 " " 0·9 " " "	6·2 " " 5·4 " " "	236 " " 15 " below "
England, N.W.	51·5 " " 2·2 " " "	5·2 " " 3·7 " " "	255 " " 11 " above "
England, S.W.	51·9 " " 1·9 " " "	5 7 " " 4·7 " " "	335 " " 20 " " "
Ireland, North	52·4 " " 1·1 " " "	5·1 " " 3·1 " " "	216 " " 15 " below "
Ireland, South	52·7 " " 1·1 " " "	4·7 " " 3·6 " " "	284 " " 5 " above "
The Kingdom...	51·6 " " 1·7 " " "	4·6 " " 3·6 " " "	272 " " 10 " " "

Scientific News

FOR GENERAL READERS.

Vol. II. NOVEMBER 16, 1888. No. 20.

CONTENTS.

SCIENTIFIC TABLE TALK.

By W. Mattieu Williams, F.R.A.S., F.C.S.

One of the common troubles to which laboratory workers, and more especially laboratory martyrs (*i.e.*, the hard-worked, ill-paid, and unglorified assistants), are subjected in the course of chemical work, is that of "*bumping*."

Certain liquids must be boiled, continuously boiled, in some cases to effect solution, in others for evaporation sake. Docile solutions submit quietly and amiably to such treatment; the bubbles of vapour are formed immediately the boiling point is reached, they are small and numerous, and detach themselves freely from the heated sides of the containing vessel. But certain other disagreeable liquids behave very differently. They rebel against the discipline of boiling, sullenly persist in remaining calmly in the liquid form even when their temperature is raised above their unquestionable boiling point, clinging with stubborn tenacity to the smooth sides of the heated vessel. Presently, however, their obstinate resistance is overcome by the expansive energy of additional heat.

The junior student who begins his work in qualitative analysis by heating his solutions in test tubes, frequently obtains a striking demonstration of the final result of this contest. Finding that his solution does not boil in accordance with his theoretical anticipations, he looks down the tube to see what is the matter, when suddenly a great bubble of vapour filling the lower part of the tube is explosively formed, and more or less of the liquid is projected to his face. As solutions of caustic potash and soda, and of sulphuric acid (oil of vitriol), are specially addicted to such proceeding, the demonstration may be unpleasant to the operator, who speedily learns to treat heated test tubes as old sportsmen treat gun barrels; he never presents their mouths towards himself or his friends.

In more advanced work, where beakers or flasks are used, this sudden formation of the big vapour bubble and its collapse jerks the vessel on its stand with a violent bump, from which the term "bumping" is derived. A flask may thus be broken, and the work of a whole day, or of several days, be thereby wrecked, or some drops of solution may be ejected from an open-mouthed beaker or evaporating dish, and thus a quantitative analysis be altogether spoiled. The smoother and cleaner the containing vessel the greater the liability—other conditions equal—to this bumping, and in chemical analysis the uttermost extreme of double-Dutch cleanliness must be observed.

If the vessel or liquid be decidedly dirty in the sense of holding particles of foreign matter, bumping rarely occurs, because the grasp of the liquid upon mere points is very weak. This may be shown by boiling water or any other liquid in a glass vessel which has one or more projecting points of roughness on its surface. By watching them during the heating it will be seen that, just as the liquid reaches its boiling point, streams of minute bubbles of vapour will pour from these points. The like occurs when any other gas is disengaged from a liquid, as, for example, the carbonic acid gas from champagne or other sparkling liquid. Ordinary drinking glasses commonly have such points on their surfaces, and from these may be seen such issuing streams of gas bubbles after the general effervescence has ceased.

To prevent bumping, chemists have imitated this by putting foreign solids into the liquid, solids that are insoluble and do not taint the liquid, such as pieces of charcoal, platinum wire, etc.

But there are some liquids that resist even these, or in which their action is uncertain and variable. A Russian chemist, W. Markownikoff, has lately struggled with this practical problem, and finds that coating the inside of the vessel with a thin deposit of silver is effective, but the silver film easily breaks off. His best results were obtained by using very thin capillary glass tubes, such as are easily obtained by heating an ordinary small glass tube in a gas or spirit lamp flame, and drawing it out when red hot. A hair-like thread is thus formed, which, however fine, remains tubular, as may be proved by breaking it asunder, placing the fine end under water, and blowing through the original undiminished tube. A small cloud or stream of minute air bubbles is thus blown into the water.

Markownikoff cuts up such hair-like tube into short pieces from $\frac{1}{8}$ to $\frac{3}{8}$ of an inch in length, seals up one end, which is easily done by holding it for a moment in a flame either before or after cutting it off. A few of these minute open-mouthed bottles, each containing a microscopic elongated air-bubble, are dropped into the liquid, which then boils gradually and without violence, the steam bubbles proceeding from these nuclei.

Tomlinson, who long ago studied the subject of nuclei, showed that minute air-bubbles are the most effective, not only in promoting ebbuliton, but also in the opposite action of initiating solidification. Thus, clean water that has been previously boiled, or water free from solid or gaseous particles, may be brought down considerably below the freezing point without freezing, if it stands undisturbed in a smooth vessel; but if a solid particle be dropped into it, and that particle has air adherent to it, or forces a little air down with it, crystals of ice are instantly formed. Supersated solutions of crystalline salts behave in the same manner; many of them very strikingly. This is notably the case with sulphate of soda.

The familiar experiment of stirring champagne with a piece of bread after ordinary effervescence has ceased, and thereby renewing it, is an example of this action of gaseous nuclei, the efficiency of the bread depending on its porosity and the air contained within its pores.

On one occasion I assisted at a Scandinavian midnight revel in the ancient capital of the Vikings. We emulated those Vikings by repeating their drinking ceremonies. When the bumpers were all adjusted, each man rose, thus with the others forming a circle round the table, each lifted his tall glass by the stem, raised it over head to full arm's length, then each reached forward, clashing all the glasses together in the centre of the circle and yelling out "skaal," in chorus to the clang. The liquor was champagne in the old-fashioned, tall, narrow glasses; much was spilled at the skaal, and the sparkling of what remained in the glass was much abated. Then the Norsemen performed a curious exploit. They rested their glasses on the table, upraised their outstretched hands, and brought down the palms with a heavy thump upon the mouth of the glass. This was immediately followed by a superficial re-effervescence that covered the surface of the wine with a head of white foam.

I repeated the performance and studied the phenomena, and found that, when thus struck and pressed, the flesh of the palm bulged downward into the glass, and sensibly rested upon an elastic cushion of compressed air. It had acted like the pressing of a piston into a closed cylinder, and evidently drove some of the air into the liquid at its surface, where the new effervescence occurred.

These and other facts that might be specified justify the conclusion that the action of Markownikoff's little tubes mainly depends upon the little measure of air they contain, though in the abstract I have read (Journal of the Chemical Society, November, 1888, page 1,155) no such explanation is suggested.

The abstractor, B. Brauner, adds that he has tried the device, "and found it invaluable, especially for the distillation of concentrated acids."

I should add that a short capillary tube with one end closed retains the air it contains with curious tenacity, and that it is probably condensed therein very considerably by its adhesion to the walls of the tube. A larger tube thus filled with air and immersed in a liquid with mouth upwards, is speedily filled with the liquid, the air bubbling into the water. Not so the short capillary tube. Strive as you may you cannot fill it with water if dry air has once taken up its quarters within it.

THE MARINE ZOOLOGICAL STATION AT ALGIERS.

DR. CAMILLE VIGUIER gives in *La Nature* an account of this institution, interesting as being the first of the kind established on the Southern or African shores of the Mediterranean. It occupies a small plot of ground on the peninsula of the Admiralty, and the building is shown in the accompanying illustration (fig. 1), for which we are indebted to the courtesy of the publishers of *La Nature*. It has the disadvantage of a close proximity to the coaling-station of the navy, so that there can be no windows upon this side up to the level of the first floor. This deprives the laboratories of the north light, well known to be the most favourable for microscopic work, and compels the tanks to be placed on the south side. It has, however, the advantage of proximity to the city, and of thus enjoying a regular supply of fresh water and of gas. The water is at a pressure sufficient to rise to the level of the terrace. The gas is distributed throughout as a source of heat, and, if needful, of light, and it furnishes besides the motive force necessary to pump sea-water and to drive the small dynamo which ordinarily supplies light to the whole establishment. Sea-water is taken, in ordinary weather, from the open sea, and a rotatory pump forces it into two reservoirs on the terrace. Thus salt water is distributed throughout the station at a pressure which in the tanks of the basement exceeds one atmosphere.

Though thus supplied from the open sea, the station is in the harbour, sheltered from the waves, and boats can always be used, except in extraordinary weather. The fishermen already begin to bring in curious animals which they find, and which are not marketable, and probably in this way interesting specimens will be secured.

The building contains cellars, stores, the machinery, and on the south side a long sink which can receive tanks of all shapes, fed at will either with fresh or salt water. This room is sufficiently illuminated by lights made obliquely in the masonry, in which are lodged the large tanks of the ground floor. The tanks on the ground floor are about a cubic metre in size, and are attended to from without by means of an iron gallery, reached by stairs. They are protected by means of glazed frames shaded by blinds. These tanks, fitted with rock-work, like the external tank, are so transparent that it has been possible to photograph a new *Alcyonaria*. All the tanks can be illuminated from without by means of an arc lamp, which serves for microscopic photography. The first floor is devoted to laboratories and a library.

As the establishment has not been created for the amusement of the public, and as the tanks are destined merely for the service of the station, it was considered that four large tanks would be sufficient for observing the animals in almost normal conditions, and that it would be better to reserve the remaining space for tanks glazed on all four sides, in which specimens which it was desirable to have always at hand could be kept.

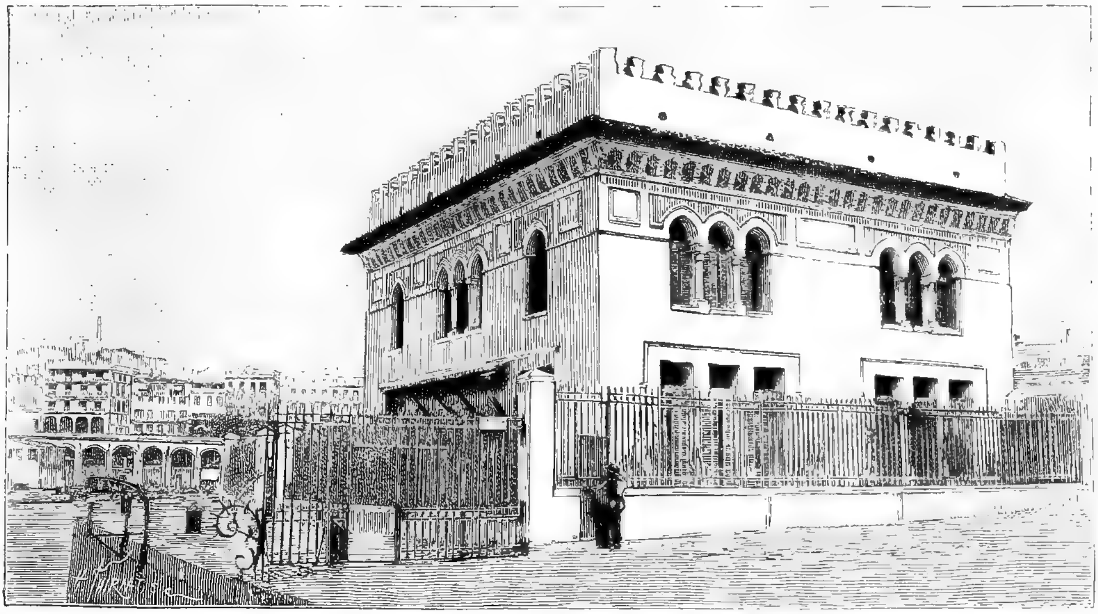

Fig 1.—Marine Zoological Station at Algiers.

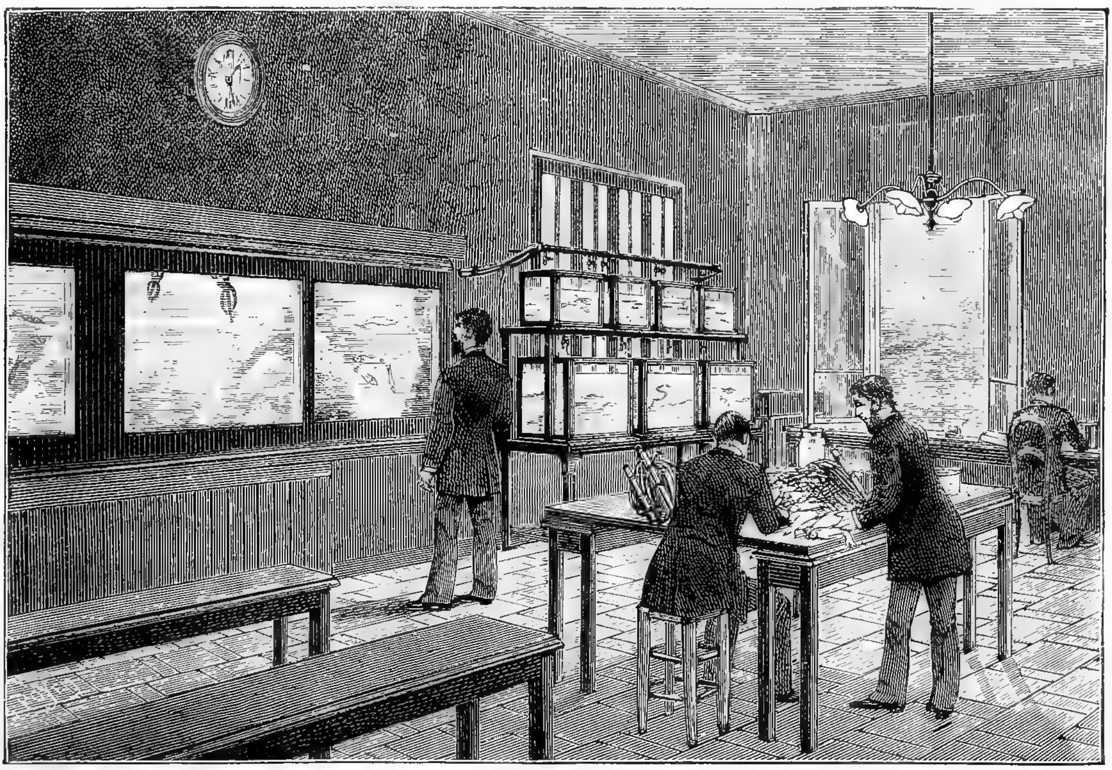

Fig 2.—Laboratory of the Marine Zoological Station at Algiers.

Fig. 2 shows the arrangement of these tanks, placed on iron frames in front of the large windows. The corners of the room, which are of course darker, are occupied by two stages of flat tanks. The large room on the ground floor, which serves also for a lecture-room and a laboratory, has a perfectly symmetrical arrangement. As the fresh-water fauna is still imperfectly known, each of the tanks on the west side may be fed either with fresh or salt water.

The outer tank of about eight cubic metres' capacity may serve, if needful, for animals of large size.

The reserves are entrusted to a small floating vivarium.

The laboratories of the first floor contain a long, flat sink, which are provided with two gas jets for heating a stove and a chafing-dish ; two cocks for fresh and salt water, both at sufficient pressure to work filter-pumps ; and two porcelain cocks for distilled water or alcohol. These sinks are fitted to receive small aquariums of from 60 to 80 litres, which a cart may take to the edge of the quay, and which may be lowered into the boat by means of a crane. The most delicate animals may thus be conveyed from the water's edge to the tanks in the station.

In each laboratory there is also a third gas jet for apparatus which may be needed on the work-table. Arrangements are being made to forward specimens and preparations to such naturalists as may require them for their studies.

ROMAN REMAINS AT LLANTWIT-MAJOR.

(Continued from p. 478.)

IN spite of the temptation to digress at this point, the plan of excavation was adhered to, and the trench was continued. A large fragment of a pillar was found, then

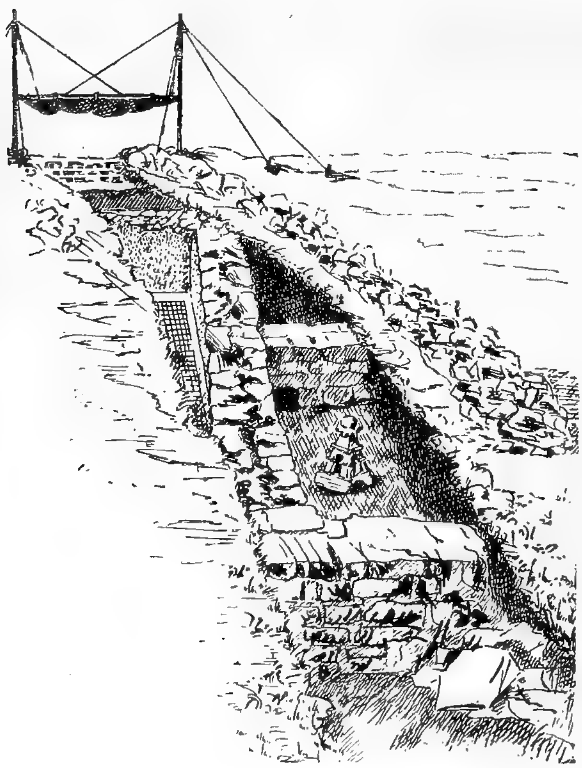

Fig. 2.—View of Trench.

the angle of the other side of the last wall, and a continuation of the longer wall from 27 to 44 feet, where another corner was observed, and in this, the third enclosed space, another fragment of a pillar, with ornamental base and many fragments of plaster, was encountered. In this way the trench work was continued, opening up two more enclosed spaces and passages, and yielding coins and a finial, among other articles and fragments of interest. At a distance of 54 feet from the third enclosed space a hypocaust was exposed for a length of 25 feet in the direction of the

Fig. 3.—Finial.

trench ; all the blocks of masonry and flues were very distinct, whilst at the entrance, on some steps, the skeleton of an old woman was found.

Our illustration (fig. 2) represents portion of the trench-work, showing the finial *in situ*, as discovered. Other points, such as the hypocaust at the end, the angles of walls, the bit of tesselated pavement, etc., will be readily distinguished.

The separate illustration (fig. 3) of the finial shows the ornamental character of this architectural fragment, and there can be very little doubt but that it formed part of an erection of considerable artistic pretensions.

The trench now extended some 300 feet, and in a period of a fortnight or so sufficient evidence had been brought to light to show that a Roman habitation of no mean degree lay hidden in that field at a depth of only a few feet; all the discoveries tended to support that view—the entrance-walls, the numerous rooms and passages, the tesselated pavement and the ornamental walls, the fragments of the pillar and finial, the extent of the hypocaust, etc.

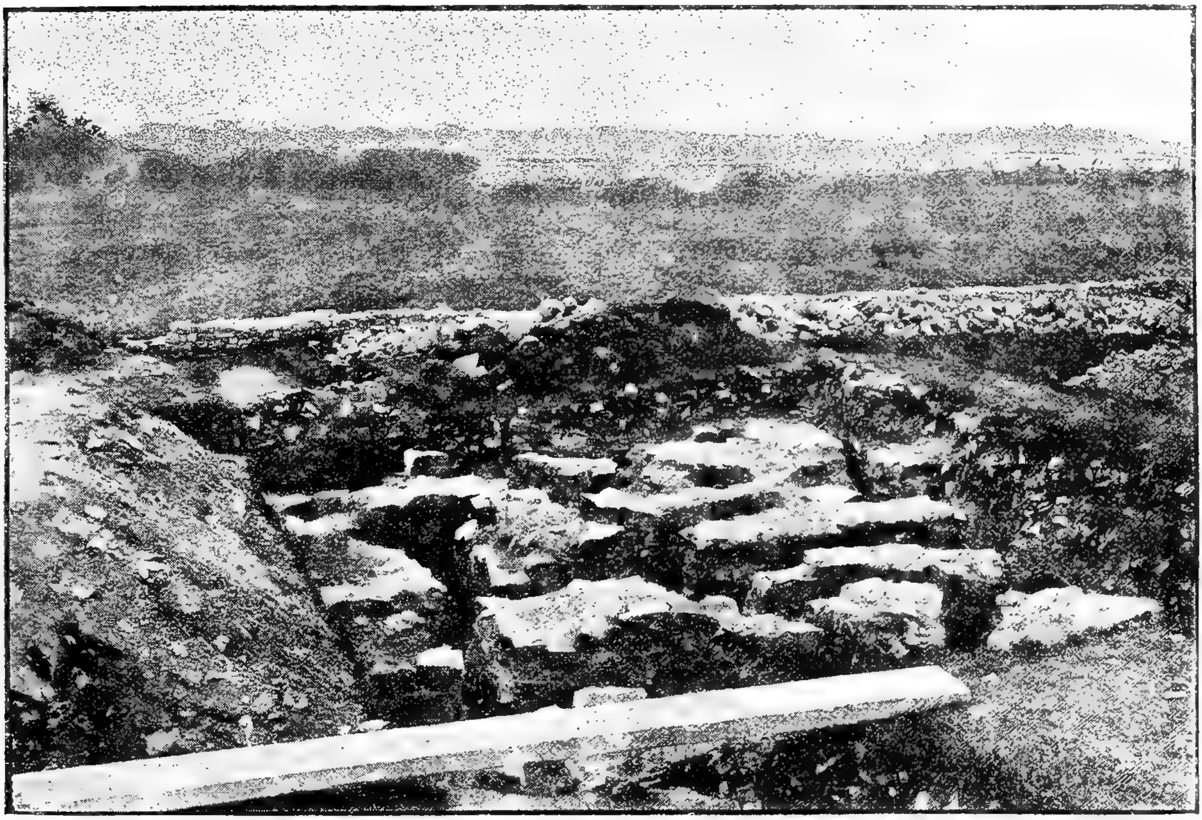

FIG. 4.—HYPOCAUST.

It will be a matter of no surprise that it was now determined to open up some of the treasures touched during the progress of the trench, and therefore excavations were continued in those places where enclosed spaces had been encountered. The bath, or hypocaust (shown in fig. 4), was found to be a chamber 22 ft. 9 ins. wide, and at least 25 ft. long, all the flues being in perfect condition, and in parts 2 ft. 6 ins. deep. The first enclosed space was found to measure 10 ft. by 16 ft., the second 27 ft. by 20 ft., with a large opening into another room, probably about 22 ft. square.

Long ere this stage had been attained the enthusiasm of many members of the Cardiff Naturalists' Society had been aroused, and some of the energetic members came to the assistance of Mr. Storrie in his interesting labours;

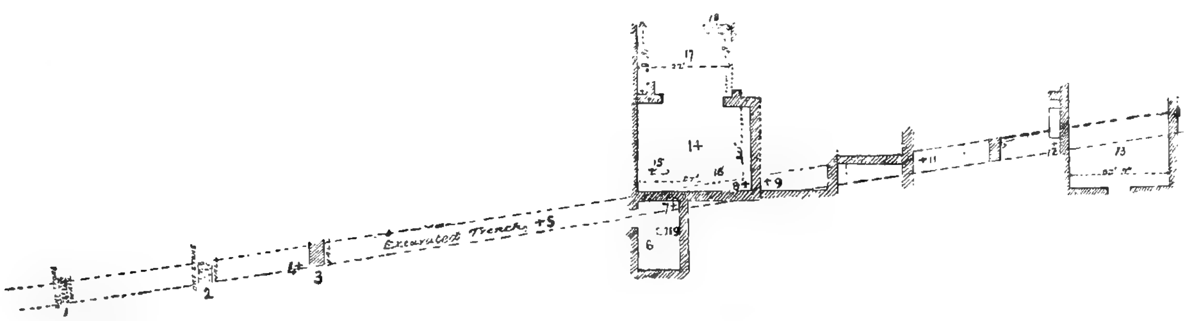

FIG. 5.—PLAN OF THE EXCAVATIONS. (Rough edges indicate sides of walls unexplored.)

among others, Mr. Progers and Mr. T. H. Thomas, the president of the Society, who had, *ex officio*, been a prime mover in the work, now came forward and excavated a good portion of the beautiful tesselated pavement, of which we give an illustration and description below, whilst Mr. J. Bell, C.E., drew the plans, and Mr. C. T. Vachell, M.D., looked after the business and legal matters. Owing to the joint exertions of these gentlemen on the occasion of our visit in September, things had assumed the stage of advance indicated in the following plan; the dotted lines show the course of the trench, whilst the various points of interest are numbered and duly indicated :—

1. First dry stone wall.
2. Second " "
3. Stone and mortar wall.
4. Urn of black pottery.
5. Part of bronze fibula.
6. First enclosure.
7. Part of quern.
8. Large portion of pillar.
9. Fragment of pillar with base.
10. Finial.
11. Coins.
12. Remains of old woman.
13. Hypocaust.
14. Second enclosure: room with tesselated floor.
15. Grave with human (female) remains.
16. Impression of horse's hoof.
17. Another room.
18. Graves with human remains.
19. Rectangular solid foundation.

(*To be continued.*)

THE PREVISION OF EARTHQUAKES.

UNDOUBTEDLY the attempts at foretelling destructive natural phenomena, such as tempests, floods, or earthquakes, meet with very general attention, but do not as a rule encounter either the confidence or the distrust which they merit. Hence it is required, in the interests of true science, that specialists—unpleasant as the task may prove—should undertake an examination of the data and the assumptions upon which such prophecies are founded. With especial reference to the last great earthquake in the Riviera, on February 23rd, 1887, Professor Hein takes occasion to undertake, in the *Naturforscher*, a thorough-going exposition of the notorious earthquake predictions of Falb.

At present geology distinguishes three kinds of earthquakes :—*Collapse earthquakes*, due to the subsidence of subterranean caverns, and felt over a very narrow space, are but of slight importance. *Volcanic earthquakes* are usually the forerunners of eruptions, and are, therefore, limited to volcanic territories. They never extend over wide regions, but the number of shocks is often very considerable. The *dislocatory* or *tectonic* earthquakes are the most common and the most important. Though without any direct connection with volcanoes, they agitate extended regions of the earth's surface, and take place along certain zones or lines of previously-existing displacements of the strata. Where such shocks are numerous, they occasion permanent displacements of the surface, which are even capable of measurement. As an example may serve, the triangular region Lägern—Rigi—Napf, in which the first-named point has moved nearer to the two latter by a metre (39 inches) in the course of the last thirty years.

Some time ago A. Perry, of Dijon, collected statistical evidence on earthquakes, and considered himself entitled to assert that these catastrophes occurred more frequently at new and full moon than at other times. This led him to the hypothesis of a tidal movement in the liquid interior of the globe, earthquakes being thus due to the action of a spring-tide. Though Perry himself subsequently ceased to advocate his hypothesis, it found a champion in Rudolf Falb, who considers all earthquakes as subterranean volcanic outbreaks occasioned by the attraction of the sun and the moon.

The only evidence advanced by Falb in support of his theory was of a statistical character, and this he does in a manner open to objections. Thus he ignores the great earthquake of Villach in 1348, which was unfavourable to his hypothesis. He also assumes that the earthquakes may occur from three to five days earlier or later, though the total interval between the times of their supposed maximum and minimum occurrence is only seven days. The same convenient liberty, we may remark, is claimed by those meteorologists who expect a change in the weather at the quarters of the lunation.

Further, since systematic observations of earthquakes have been collected, they have been found almost of daily occurrence. In the year 1880 fifty-nine shocks were experienced in Switzerland, and in the following year 166. From August 1st, 1870 to August 1st, 1873, there occurred in the Greek province Phokos 300 destructive shocks and 50,000 slight agitations. We may therefore assume, with a great probability, that in his earthquake statistics Falb has scarcely taken into consideration a thousandth part of the earthquakes which have occurred during the same time.

A discussion of the recent statistics of earthquakes shows in some groups no connection with the position of the moon. In other series there appears an excess of a few per cents. at full and new moon, as against the intermediate quarters. From the great frequency of earthquakes there can be found not merely slight but severe shocks, which agrees with Falb's supposition. But the same statistics show plainly that the moon is not the primary, nor even the secondary, cause of earthquakes. Its influence is restricted to facilitating by a small percentage the release of the tensions produced by other causes in the crust of the earth at the times of spring-tide.

Falb exaggerates the action of the tides of the earth's nucleus in another direction. The solid crust of the earth, he admits, is plastic enough to yield to a tidal wave of, at the outside, a foot in height, and to accommodate its form accordingly. This is evident, as the solid matter passes downwards into the liquid state, not abruptly, but by intermediate stages of a plastic character. Further, on Falb's hypothesis, the subterranean earthquakes must be the most common, and the shocks must proceed from a central point—both of which points are very rarely experienced. Lastly, the prediction of further shocks in a district which has been visited by destructive agitations is no particular proof of acuteness. It has long been known that every somewhat severe earthquake is heralded by some faint, often scarcely perceptible, shocks. Then comes the main convulsion as a group of shocks in rapid succession, followed for months or years by great agitation, until the disturbed strata have come to an equilibrium, and the threatening tensions in the regions concerned have entirely or chiefly disappeared. And these tensions in the earth's crust depend not on a tendency to subterranean outbreaks, but upon the subsidence of the crust upon a contracting nucleus.

THE MIRAGE AGAIN.—According to *Cosmos*, a most remarkable case of mirage was seen at St. Maurice (Valais) on October 11th last. There was seen—evidently in the night, though the exact hour is not given—the image of a splendid cathedral as if projected on a white cloud. Buttresses, bell-turrets, and the tower, with its lofty steeple, were all seen by several spectators during at least half an hour. Supposing that there is no exaggeration in the description, we have here a problem no less difficult than interesting.

General Notes.

University College, Liverpool.—Mr. Henry Tate has presented the sum of £16,000 to the council of this college for the erection of the library block of the college buildings.

The Value of Higher Education.—The following significant advertisement is quoted from the *Birmingham Daily Post*:—"2d. per hour. French, German, natural history, mathematics. Privately. University man. B.Sc."

Apiculture Abroad.—In Austria apicultural societies and publications receive subventions from Government to the yearly amount of 20,000 florins. In France similar aid is extended to the very modest figure of 43¼ francs!

Dr. W. Spottiswoode's Mathematical Works.—The mathematical papers of the late President of the Royal Society (Dr. W. Spottiswoode) are to be brought out in a volume. The task of collecting and editing has been deputed by Mrs. Spottiswoode to Mr. R. Tucker, the editor of Clifford's *Mathematical Papers*.

Contamination of Water.—Professor E. H. S. Bailey remarked at the last meeting of the American Association (quoted in *Popular Science Monthly*), that ammonia may be sometimes a natural constituent of waters and not indicative of any animal pollution.

Utilisation of Atmospheric Nitrogen.—Dr. Charles Marcel, of Ouchy, has offered the trifling prize of 1,000 francs for the best investigation of the use of atmospheric nitrogen in food. He who devises a practical means of fixing atmospheric nitrogen will gain millions, always supposing that he is not robbed of his invention.

An Indicator of Electric Currents.—A simple contrivance for showing whether or no a wire is traversed by an electric current is due to Mr. P. B. Delany. The instrument is a ring which can be worn on the finger and which contains, instead of a stone, a small compass. On approaching this ring to a conductor the needle indicates the passage of a current.

The Flying Machine.—Professor Joseph Le Conte thus summarises the prospects of these devices:—"A pure flying machine is impossible. All that we can expect—all that true scientists do expect—is a skilful combination of the balloon-principle with the true flying principle to make aerial navigation possible in moderately favourable weather."

Absence of Oxygen in the Sun.—From spectroscopic observations lately made at the Grand Mulets, on the ridge of Mont Blanc, M. Janssen, of the Academy of Sciences, concludes that oxygen does not exist in the sun's atmosphere in a state capable of producing the spectral manifestations which it gives in the earth's atmosphere. The spectral lines and bands of oxygen disappear the higher we ascend.

The Intermittent Lake of Carniola.—Herr Putik (*Popular Science Monthly*) has lately re-examined this lake in order to ascertain the cause of its periodical emptying and filling. An enormous cave, known as Karlovka, situate at the north-western angle of the lake, serves for the outlet of the overflow. It lies at the foot of a range of perpendicular rocks and leads to a chain of underground lakes, five of which Herr Putik has explored.

Origin of Human Fear of Darkness.—Dr. F. Oswald (*Popular Science Monthly*) points out the timidity of our "poor relations" after nightfall. "In the daytime the restless vigilance of the tree-man enables him to hold his own against his wiliest foes. But after sunset the owl-eyes of the prowling Felidæ give them a fatal advantage, and the instinct of *night-fear* may thus deeply and perhaps indelibly have impressed itself upon the mental organism of our forefathers."

Royal Institution of Great Britain.—At the general monthly meeting held on Nov. 5th, Sir James Crichton Browne, M.D., F.R.S., vice-president, in the chair, Mr. Amand Routh, M.D., was elected a member. Seven candidates for membership were proposed for election. The special thanks of the members were returned for the following donation to the fund for the promotion of experimental research:—Mr. Lachlan Mackintosh Rate, £50.

The Heat of the Sun.—According to recent observations the heat of the sun at any given place is not constant, but is liable to considerable variations. In 1883, from the beginning of July to the middle of August there was an increase of heat of 6 per cent.; from then to the middle of September a decrease of 8 per cent.; from the middle of September to the middle of October there was little change. At the beginning of June, in September, and in October, the sun was covered with a great number of spots. In August there were much fewer spots. The solar heat seems to vary inversely as the number of spots.—*Astronomie.*

The Distance of the Sun.—The results of the American observations of the last transit of Venus, in 1882, have been tabulated and summarised by Professor Harkness. Ten stations of observation had been established in the United States, and 1,472 photographs of the transit had been taken. The mean of the results gives the parallax as 8·847 min.; that is, the mean distance of the earth from the sun is about 92,385,000 statute miles. Professor Newcomb had, 20 years ago, estimated the parallax at 8·848 min.; and the American astronomers estimate the possible error at not more than 130,000 English miles.

The Late Mr. Richard A. Proctor.—A petition, which has already been extensively signed by some of the most distinguished men in science and literature, is being drawn up to the First Lord of the Treasury in favour of the claims of the widow and children of the late Mr. Richard A. Proctor to a pension under the Civil List in consideration of Mr. Proctor's services to science and to the popularising of science. Mr. Proctor left a family of six children by his first wife and two by his second. The total resources of his widow are stated to be not more than £150, and one of his sons suffers from an incurable hip disease.

Mirages.—On July 15th last, about 11 a.m., at Hudikwall, on the Baltic, a great number of spectators saw in the fields a singular effect of mirage. They perceived a ship capsizing in a sea which was fearfully agitated, and a large boat just leaving her. The apparition was visible for about five minutes. In the beginning of August, according to the Austrian papers, there was observed at Vidorec, near Warasdin, an extraordinary mirage in the vast plains surrounding this locality. There were distinctly seen numerous divisions of infantry going through evolutions at the command of a leader of lofty stature. This phenomenon lasted several hours during three successive days. Inquiries were made if any divisions of infantry had been manœuvring at a distance, and if these evolutions had been rendered visible at Vidorec by a mirage, but nothing of the kind could be ascertained.

The Municipal Laboratory in Paris.—In this useful institution there have been examined and condemned in 1887, as unfit for human food, 165,410 kilos (the kilo = 2 lbs. 3 ozs.) meat and fish; 446,900 kilos of vegetables and fruit; 14,500 kilos preserved fruits and fruit-juices; 123,325 kilos mushrooms and tomatoes. Whilst in July, 1886, of 100 samples of beer examined, 55 were found sophisticated with salicylic acid, and in December of the same year 7 per cent., last year the proportion of adulterated samples had fallen to 3 per cent. In milk there is also an improvement. In 1886, 23 per cent. of the samples were found to have been watered, but last year only 21 per cent. The case is worst with wines. Of the 7,295 samples tested, only 3,071 were found pure. The residue—more than one half—had been either watered, "plastered," or mixed with salicylic acid, colouring matters, etc.

Refining Silver by Electricity.—According to the *Chronique Industrielle*, the method of Moebius for refining silver by electricity is being brought into extensive use. It is especially suitable for the treatment of auriferous silver containing about 11 per cent. of gold. The expense is about $1\frac{2}{8}$ franc per kilo. Moebius employs in an ordinary electrolytic bath anodes of argentiferous matter, and a thin plate of pure silver as cathode. The bath is a weak solution of nitric acid at 1 per cent. The anodes, which are about 12 millimètres in thickness, are placed in muslin bags, which retain the gold, platinum, peroxide of lead, and other foreign bodies contained in the matter. The current employed is of 150 ampères, with a difference of potential between the plates of one volt. During the whole operation brushes pass and repass over the surface of the cathode, and cause the silver deposited to fall to the bottom. If the matter contains copper, it dissolves in the nitric acid, but it is not deposited upon the cathodes.

Great Ocean Depths.—Her Majesty's surveying ship *Egeria*, under the command of Captain P. Aldrich, R.N., has, during a recent sounding cruise and search for reported banks to the south of the Friendly Islands, obtained two very deep soundings of 4,295 fathoms and 4,430 fathoms, equal to five English miles, respectively, the latter in latitude 24° 37′ S., longitude 175° 8′ W. the other about twelve miles to the southward. These depths are more than 1,000 fathoms greater than any before obtained in the Southern Hemisphere, and are only surpassed, as far as is yet known, in three spots in the world—one of 4,655 fathoms off the north-east coast of Japan, found by the United States steamship *Tuscarora;* one of 4,475 fathoms south of the Ladrone Islands, by the *Challenger;* and one of 4,561 fathoms north of Porto Rico, by the United States ship *Blake*. Captain Aldrich's soundings were obtained with a Lucas sounding machine and galvanised wire. The deeper one occupied three hours, and was obtained in a considerably confused sea, a specimen of the bottom being successfully recovered. Temperature of the bottom, 33·7 deg. Fahr.

Secular Depression of Land in France.—A long series of observations has been carried out all over France since the year 1884 for the purpose of detecting any variations of level of the land. These observations have been conducted by men belonging to the Génie corps under specially selected officers. The result of this series of observations is most important. It would appear that a secular depression from south to north is in progress. While on the coast of the Gulf of Lyons no alteration of level has been noted, on the line between Marseilles and Lille, a stretch of 820 kilomètres, the ground is sinking towards the north at the very serious rate of three centimètres yearly. It is noteworthy that the direction of the sinking is complicated; it is about three times greater towards the north-east than in the direct line from south to north. The rate along the line of the meridian is about one millimètre yearly on every 27 kilomètres; whereas it is one millimètre on every ten kilomètres in a north-easterly direction. Should this rate of depression continue, north-eastern France would in the course of a few centuries encounter a calamity similar to that which, at the end of the 13th century, befell the Netherlands.

The Public Health.—The Registrar-General's return for the week ending November 3rd shows that the deaths registered during that period in twenty-eight great towns of England and Wales corresponded to an annual rate of 19·6 per 1,000 of their aggregate population, which is estimated at 9,398,273 persons in the middle of this year. The six healthiest places were Brighton, Birkenhead, Derby, Nottingham, Portsmouth, and Halifax. In London 2,373 births and 1,613 deaths were registered. Allowance made for increase of population, the births were 534, and the deaths 27, below the average numbers in the corresponding weeks of the last ten years. The annual death-rate per 1,000 from all causes, which had increased in the six preceding weeks from 15·8 to 21·2, declined again last week to 19·7. During the first five weeks of the current quarter the death-rate averaged 19·2, and was 0·1 below the mean rate in the corresponding periods of the ten years 1878-87. The 1,613 deaths included 1 from small-pox, 88 from measles, 24 from scarlet fever, 32 from diphtheria, 19 from whooping-cough, 22 from enteric fever, 34 from diarrhœa and dysentery, and not one from typhus, ill-defined forms of fever, or cholera; thus, 220 deaths were referred to these diseases, being 19 above the corrected average weekly number. In Greater London 3,124 births and 2,025 deaths were registered, corresponding to annual rates of 29·5 and 19·1 per 1,000 of the estimated population. In the outer ring 11 deaths from measles, 10 from diphtheria, and 10 from diarrhœa were registered. Measles caused 5 deaths in West Ham and 2 in Leyton sub-districts; and 2 deaths from diphtheria were returned in Croydon, in Kingston, and in Tottenham sub-districts.

ON VERNATION AND THE METHODS OF DEVELOPMENT OF FOLIAGE, AS PROTECTIVE AGAINST RADIATION.

A Paper read by the Rev. George Henslow, M.A., F.L.S., F.G.S., before the Linnean Society, and Reprinted from the Journal by permission of the Society.

In his work on "The Movements of Plants," Mr. Darwin says:—"The fact that the leaves of many plants place themselves at night in widely different positions from what they hold during the day, but with the one point in common, that their upper surfaces avoid facing the zenith, often with the additional fact that they come into close contact with opposite leaves or leaflets, clearly indicates, as it seems to us, that the object gained is the protection of the upper surfaces from being chilled at night by radiation."*

He furthers adds† :—"We exposed on two occasions during the summer to a clear sky several pinned-open leaflets of *Trifolium pratense*, which naturally rise at night, and of *Oxalis purpurea*, which naturally sink at night (the plants growing out of doors), and looked at them early on several successive mornings after they had assumed their diurnal positions. The difference in the amount of dew on the pinned-open leaflets and on those which had gone to sleep was generally conspicuous; the latter were sometimes absolutely dry, whilst the leaflets which had been horizontal were coated with large beads of dew. This shows how much cooler the leaflets freely exposed to the zenith must have become than those which stood almost vertically, either upwards or downwards, during the night.

"From the several cases above given there can be no doubt that the position of the leaves at night affects their temperature, through radiation, to such a degree that when exposed to a clear sky during a frost it is a question of life and death."

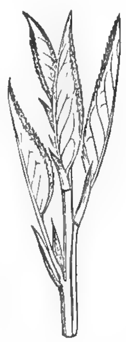

Fig. 1.—Portugal Laurel.

It is the object of the present communication to show that many, perhaps the majority of, leaves as they develop on the expansion of buds in spring assume the same positions as leaves of those particular plants which are remarkable for sleeping at night, and appear to exhibit a similar care, but in a more perfect way, in protecting the upper surfaces; and the inference to be drawn from all the phenomena presented by young growing leaves, as it seems to me, is the same, namely, to shield their upper surfaces especially from injury caused by radiation—viz., chill and desiccation. Moreover, it is not an unusual thing for the young leaves only to be subject to hypnotism, the older ones ceasing to rise and fall by day and night: thus Mr. Darwin mentions *Melilotus* as an instance; and I find it is the same with the French Bean. Lastly, experiments made to test this theory are decidedly corroborative.

Vernation, as explained and illustrated in text-books on botany, and on page 33 of this volume of Scientific News, is solely concerned with the various methods by which the rudimentary leaves are folded up in the buds of different plants; and the internal wooliness, as well as external resinous matters, etc., are usually regarded as being safeguards against injury to the buds within from the severity of winter weather. Beyond that surmise I am not aware that any attempt has ever been made to offer any *rationale* of the processes of vernation; nor has any one noticed the special behaviour of developing leaves and stipules, as well as of the axes and petioles which support them. If, however, we keep in view the two assumed objects—first, the securing an erect or dependent position of the blades so as to place their surfaces in a plane at right angles to the surface of the earth; and secondly, the protection of the upper surfaces,—it will be seen how various are the efforts of nature to secure these two ends during the period of development, and while the young leaves and shoots are succulent and delicate, such being only too readily, and often severely, injured by the cool nights, sharp frosts, and cutting winds of spring, at the very time when the buds are expanding. The various methods of protection are more perfect than in sleeping plants, inasmuch as the young leaves are more delicate than when adult. Testing the effects of desiccation by the heat of the sun, I found that when young clover-leaves, naturally conduplicate, were forcibly spread out with the upper surfaces exposed to the sun for twenty minutes, the edges soon curled inwards, and they lost 37·2 per cent. of weight. Those spread out with their under surfaces exposed remained flat, but lost 43·2 per cent. of weight in the same time, *i.e.*, rather more than the preceding. In all experiments with clover-leaves exposed at night, I found the differences were not so pronounced as in many other plants.

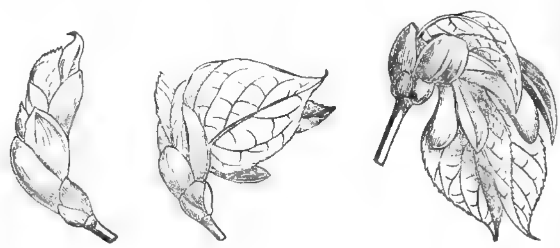

Fig. 2. Fig. 3. Fig. 4.
The Lime in Different Stages of Development.

In observing the effects of frost upon delicate leaves one sees that they are especially injured along the margins; and, moreover, where so affected, they are more or less dried up. The first fact gives a significance to the revolute and involute kinds of vernation, in which the margins are rolled outwards and inwards respectively. This led me to suspect that whenever leaves suffered from radiation not only was there a reduction of temperature, but a loss of moisture would seem to accompany the loss of heat. A similar loss of moisture would occur by desiccation, in consequence of cool dry winds, and must be equally guarded against. If this were so, then the balance would indicate the loss. With this object in view, I weighed a number of undeveloped leaves together of several plants, and made two groups of each, selecting leaves as nearly like as possible for each group of the same plant. I, then, following Mr. Darwin's method, fixed all of one group with their upper surfaces exposed upwards with card-clips, such as are use by entomologists for spreading out the wings of butterflies; the other group of leaves were laid on cork,

* P. 284.
† Pp. 293, 294.

with their leaflets naturally conduplicate or otherwise protected as in nature. In the morning I weighed each group again, and reduced their losses to percentages of the original weights of each group respectively. I found that there was in every case a generally much greater loss in the case of the leaves artificially exposed than with the others, as will be seen from the following examples :—

		Loss p. c.		Loss p. c.
Laurustinus,	exposed naturally	8·7.	Spread out,	18·7
Portugal Laurel	,, ,,	8·4	,, ,,	12·6
Lime	,, ,,	4·5	,, ,,	21·4
Laburnum	,, ,,	14·8	,, ,,	33·0
Ash	,, ,,	2·3	,, ,,	11·8
Rose	,, ,,	10·6	,, ,,	17·6
Periwinkle	,, ,,	5·0	,, ,,	12·05
Clover	,, ,,	24·4	,, ,,	29·3
Walnut	,, ,,	18·7	,, ,,	24·6

Very few nights of the month (May, 1885) were frosty, so that several attempts to carry out experiments were unsatisfactory, as so many nights were cloudy, windy, and stormy, and ill-suited for radiation ; yet on one occasion, when about three degrees of frost occurred, the Walnut, Lime, and Laburnum leaves when spread out showed to the eye unmistakable injury; whereas these three kinds of leaves, placed as they occur on the trees, did not appear to be hurt. Other leaves treated in the same way and subjected to the same slight frost did not *appear* to have suffered ; but I had not at that time thought of weighing them.

I will now add a selected series to illustrate the various methods adopted whereby the young and developing leaves are protected from injury by radiation.

I. Simple Leaves. (1) Opposite : (i) *erect.*—This position is assumed in all cases of opposite leaves which I have had an opportunity of examining. The leaves face one another with their upper surfaces more or less in close contact, concealing the bud between them. In shrubby Veronicas and Hypericums and Periwinkle the leaves are almost, as it were, glued together, so firmly do they cohere all round the margins. In others, such as *Aucuba* and *Laurustinus*, they are more slightly adjusted. The only exceptions that I have met with were Snowberry, *Weigela*, Honeysuckle, and the leaflets of the Elder, all being of the same family, Caprifoliaceæ.* The pairs of leaves had their edges involute, and one of each pair slightly embraced the opposite leaf, and so wrapped up the bud within it.

(ii.) *pendulous.* I have not met with any instance of opposite leaves being pendulous in the young state.

(2) Alternate : (i.) *erect.*—Good examples may be seen in the Common and Portugal Laurels (fig. 1). As the upper surfaces of different leaves cannot be in contact, issuing from separate nodes and at different elevations, each leaf is conduplicate, *i.e*, the two halves of the blade are folded together and thereby press their upper surfaces of the halves against one another; indeed, so tightly is this done, that it is not at all easy, in many instances, to separate them. It may be noted here that the conduplicate vernation is an extremely common one both for simple and compound leaves, and the significance of it will be now very apparent. It is sometimes further complicated by having the surfaces plicate, as in the Vine, Beech, Maple, Currant, Raspberry, etc., conditions which are probably additional safeguards against radiation.

* I first discovered this difference in *Weigela*, and that led me to examine the others, which revealed the fact that this peculiar form of vernation is an ordinal character.

As other instances of the erect position may be mentioned Rhododendron, the leaves of which, as of the Dock and Primrose, are revolute ; but those of the Violet, Pear, and Michaelmas Daisy are also erect but involute, while the Cherry has them convolute. In all these the undeveloped leaf is cylindrical or an elongated cone, erect, and offers no extent of surface, while the margins, the most sensitive parts, are specially protected.

(ii.) *pendulous.* The Lime, Hazel, and *Ampelopsis Veitchii* are good examples. In the case of the Lime, as soon as the bud expands and escapes from the winter (stipular) scales, the inner stipules develop considerably : those on the upper side are concave and ovoid and cover the upturned edges of the conduplicate leaves, which at once take a position in a vertical plane ; the stipules at the sides elongate much more than the former, furnishing some lateral protection to the whole bud, which now curves strongly downwards, and somewhat resembles a mussel in shape (fig. 2). As the bud continues to develop, the branch becomes more and more strongly curved downwards, so that the leaves are held vertically (figs. 3 and 4) ; and as the lower and older ones increase in size, they assume a horizontal position and undertake to protect the younger ones, which are concealed beneath them. Thus the protecting care is handed on to each leaf as it arrives at maturity, until the whole series are developed and the branch and leaves become horizontal.

(To be continued.)

WATER AS A CONSTITUENT OF ORGANIC SUBSTANCES.

WATER, says Dr. Whitelaw, forms three-fourths of the weight of living animals and plants, and covers about three-fourths of the earth's surface. Professor Chaussier dried the body of a man in an oven, like a brick in a kiln, and after desiccation the body weighed only twelve pounds. Rather more than a pound of water is exhaled daily by the breath, about $1\frac{3}{4}$ lbs. by the skin, and $2\frac{3}{4}$ lbs. by the kidneys, making the daily emissions of water by the body about $5\frac{1}{2}$ lbs., or not quite three quarts. The following is the percentage of water in some well-known articles :—

Wheat	15	Mangel wurzel	85
Barley	15	Cabbage (leaves)	92
Oats	16	Cabbage (stem)	84
Rye...	12	Mushroom ...	96
Rice	13	Fungi	86 to 95
Beans (field)	15	Potato	75
Beans (kidney)	23	Water melon	94
Peas...	14	Cucumber ...	96
Turnips	88	Vinegar plant	95
Carrots	83	Wheat flour	13 to 16
Rye flour	14	Cocoa	5
Barley flour	14	Manna	10
Indian corn flour	14	Figs...	21
Oatmeal	14	Plums	75
Wheat bread	44 to 48	Apples	80
Rye bread ...	44 to 49	Gooseberries	80
Cane sugar ...	5	Peaches	75
Linseed cake	10	Egg (entire)	74
Flesh	77	Milk	87
Skin	58	Blood	79 to 83
Bones (variable)	7 to 20	Gastric juice	97
Beef	74	Trout	80
Veal	75	Pigeon	79
Mutton	71	Cheese	40
Haddock	82	Brandy	56
Sole...	79	Whisky	47
Tea ...	5	Rum	30
Coffee	12	Beer	90

Natural History.

OFFICINAL RHUBARB AND GARDEN RHUBARB
(Rheum Officinale and Rheum Hybridum).

In adapting from our esteemed contemporary *Cosmos* an account of these two plants, we shall be compelled to rectify a few errors as far as garden rhubarb is concerned.

The medicinal or so-called Turkey rhubarb has been cultivated in Europe for some time, but long previously its root had been used as a tonic and purgative. All that was known about it in former days was that it was imported from Asia, and especially from China, in the form of irregular woody fragments. The Russian Government acquired a monopoly of this drug. Their commissioners, established at Kiachta, on the Chinese frontier, bought all the roots, and selected the finest for transmission to Europe, where they were sold under official supervision. Hence the Russian rhubarb is still highly esteemed in the drug trade. Since 1863, however, this monopoly has come to an end. The rhubarb is generally

met with in rounded fragments of a rather pure yellow. It broken, the fracture is marked with red and white veins. Its odour is powerful, and its taste bitter. It crackles under the teeth, and colours the saliva yellow. The lumps are pierced with holes, in which small fragments of gut-cord are often found. When the crop is gathered the lumps are strung on a cord, like a chaplet of beads, and are dried in the sun. In certain villages.

they are suspended between the horns of goats. Two other species of rhubarb are known in commerce—those of China and Persia. But there are upwards of a dozen species of *Rheum* which might yield the medicinal product, and it is remarkable that up to the last century no one knew exactly which species was preferable.

Boerhaave made some important experiments on this subject. He procured the seeds of various species of *Rheum*, and sought out the one whose roots resembled most nearly the kind employed in medicine. It is now established that this kind is the *Rheum officinale*, a native of Eastern Thibet and Western China. It is a herbaceous plant, with strong branching roots and large, broad, palmated leaves, green above and whitish below. The flowers are produced in terminal pannicles of a yellowish white. The aërial stems, and not the roots, of the plant yield the true Chinese rhubard.

According to Dr. Thorel, the genuine rhubarb is found chiefly among the high mountains of Thibet. The plant grows vigorously only on the borders of the snow-line, at altitudes of about 12,000 to 13,000 ft. The Lamas, perceiving the considerable profit to be derived from the trade in this plant, endeavour to seize possession of it. They declare that the root has a sacred character. The harvest is conducted with very peculiar ceremonies, and it concludes with terrible imprecations against all who trespass on the sacred ground until the next harvest. But it appears that, in spite of these solemn prohibitions, both Thibetans and Chinese plunder the forests, caring little for the imprecations of the Grand Lama.

In 1867 the Paris Société d'Acclimatation received from Thibet a chest containing roots of the precious plant. It has since been cultivated, and has been the subject of interesting observations, but its medicinal properties are enfeebled in our climates.

It might be an interesting experiment to try the cultivation of the medicinal rhubarb in the higher regions of the Alps or the Pyrenees.

The *Rheum hybridum* is largely cultivated as an article of food in Britain and in the United States, bearing in the latter country the name of "pie-plant." *Cosmos* asserts that the early leaves, mixed with a little sorrel to heighten the flavour, are used as a vegetable, and are considered equal to spinach.

We have only heard of one instance of rhubarb-leaves being eaten in England. A family had been beguiled by an indiscreet newspaper paragraph into trying this spring vegetable. The results were serious, as the leaves of rhubarb contain oxalic acid!

The writer goes on to say that the leaves are utilised in this manner during the months of April and May, whilst after May they are used as a material for tarts. He also ventures to assert that such tarts have a finer flavour than that of the green gooseberries so much admired in Northern France, Belgium, and England.

Every one knows that the flavour of rhubarb is coarser than that of green gooseberries, and that it quickly disappears from the markets and shops after the latter have come into season.

The leaves of rhubarb, which are not eaten, may, it is said, be boiled with potatoes and bran and given to pigs.

We may add here a brief notice of the other uses to which the rhubarb plant may be turned. In the manufacturing districts of the North, where rhubarb is cultivated on a larger scale than in any other part of England, the leaves are sometimes used in setting indigo vats for woollen dyeing, as an aid to fermentation. For this purpose the leaves are collected together, pressed, and used under the name of woad. It must be remembered that in modern days the true woad is not used on account of the trifling amount of indigotine which it develops, but merely as an aid to fermentation. Many experienced and successful blue dyers would not know whether they were employing woad or rhubarb-leaves.

A less legitimate use for these leaves is said to take place in the manufacture of tobacco.

Had it not been for the triumphant introduction of the coal-tar colours, the root of rhubarb would have been extensively used in the manufacture of dyes. By treatment with nitric acid it may be made to yield fine rose, crimson, purple, and brown shades. But as these dyes were unable to compete with the coal-tar colours, either in beauty or in price, they have fallen into complete forgetfulness.

The Influence of Sunlight on Trees.—In the latest report of the head of the Forestry Department of the United States reference is made to the effect of light on the growth of various trees. It is well known, says Professor Fernow, that light is necessary for the development of chlorophyll, and, therefore, for the life of all green plants, and especially for that of trees. The heat alone which accompanies the light is not sufficient, although the relative influence of the light and the heat on the growth is still an open question, as well as the relative requirements in light of different species of trees. In the case of forest weeds, which in forestry serve as an indication of the amount of shade which the trees exert, and with that their capacity of impeding evaporation, some require full sunlight for their development, others are averse to a high degree of light. To this must be due the change in the plants of a district when its forests are removed. Then the amount of light or shade needed is modified by site. Where the sunlight is strong, in higher altitudes, drier climates, or where the growing season is longer, or there are more sunny days, some species will endure more shade. The flora of high altitudes in general requires light. Trees nearly always develop best, in other words make most wood, in the full enjoyment of light, but their capacity of developing under shade varies greatly. The yew will thrive in the densest shade, while a few years overtopping kills the larch; the beech will grow with considerable energy under partial shade, where the oak would only just keep alive and the birch would die. When planted in moist places, all species are less sensitive to the withdrawal of light. In the open, maples, elms, sycamores, and others grow well and make good shade trees, in a dense forest they thin out and have but scanty foliage. Conifers, such as spruces and firs, which preserve the foliage of several years, have perhaps the greatest capacity of growing under shade, and preserving their foliage in spite of the withdrawal of light. In America sufficient *data* to group the forest trees according to the amount of light required by them have not yet been collected, but rules based on experience have long been formed in Germany, where the behaviour of trees under different conditions of light has been carefully studied. It has been found, for instance, that on the same branch those leaves which are developed under the full influence of sunlight are not only larger and often tougher in texture, and thicker, but that they have a larger number of stomata or breathing pores than those less exposed to light. The whole subject is one of the utmost importance in forestry, and observations and experiments are to be carried out in regard to it in the United States.

THE SAND GROUSE.—In *Humboldt* we find it stated that hitherto not a single case of this immigrant bird having produced young in Germany has come to light. Some alleged instances proved on examination to be merely partridges, or—more frequently—corn-crakes. The fact that these birds have throughout the season been seen in flocks is a proof that they have not paired.

DOCILITY OF THE FIELD-MOUSE.—According to a friend, the field-mouse is much more easily domesticated than the house-mouse. The latter seems to have an inborn, hereditary shyness which can only be eliminated by prolonged care and kindness. The field mouse on the contrary, becomes tame in a few days, and can soon be liberated for a temporary run in the garden, after which it readily returns to its owner.

SUICIDE OF SCORPIONS.—M. Serge Noirkoff, of Constantinople, writes to *La Nature* as follows:—"Having heard that the scorpion puts an end to its life if it finds itself in danger without the prospect of escape, I caught half-a-dozen of these creatures and tried the experiment. I arranged upon the ground glowing charcoal so as to form a circle to which there was no outlet. The scorpion was placed in the centre of the circle, which was so wide that it would not be incommoded by the heat. Finding itself surrounded by fire, the animal began by searching for a road to escape. Its movements, slow at first, became finally a frantic race along the circumference of the circle. It then retired to the centre, and put an end to its life by plunging its sting into its back, and in a few seconds expired with convulsive movements. The five other scorpions were then tried successively, each time with the same result."

COMPARATIVE PSYCHOLOGY.—Dr. F. L. Oswald (*Popular Science Monthly*), in a very able article, disfigured, however, by the Cuvierian title, "Four-handed Sinners," remarks that "every step in the progress of comparative anatomy has more plainly demonstrated the fact that the alleged contrasts in the construction and the functional characteristics of human and (lower) animal bodies are mere differences of degree, and a similar conclusion must force itself upon the unprejudiced observer of animal soul functions."

ANIMAL NOTIONS OF TIME.—Dr. A. S. Hudson, writing to the *Popular Science Monthly*, refutes the contention that, *e.g.*, dogs distinguish the recurrence of Sunday not by counting the days, but by perceiving certain peculiarities in the movements about the house, etc. Dr. Hudson mentions a herd of five cows to which salt was always given every Sunday. On that day, accordingly, they always collected at the gate, waiting for the customary dole. Now, the field where they grazed was remote from the house, isolated from the outer world, and away from any thoroughfare. From week to week, and from month to month, they saw no person except the man who milked them, and had no conceivable means of distinguishing Sunday—to them salt-day—save by the lapse of days.

THE PROBOSCIS OF THE ELEPHANT.

WE need not dwell upon the mingled strength and flexibility of the elephant's trunk, which are sufficiently illustrated by anecdotes familiar to every child. The internal structure of this marvellous organ is less generally known, and the very few who have had an opportunity of dissecting it are by no means agreed as to the meaning and use of some of its arrangements. A cross-section of the trunk is triangular near the base, elsewhere rounded. The side next to the mouth is flattened. Towards the middle of the section, but a little nearer the front than the back surface, are seen the cut ends of two tubes side by side. These are the nostrils, which are lined by a thick yellow layer, upon which is spread a thin, moist, and sensitive mucous membrane Many small muscles radiate outwards from the nostrils connecting them with the skin, while transverse muscular fibres pass across from side to side, between and behind the nostrils. Lastly, a great number of longitudinal or semi-spiral muscles enclose the others, passing to the skin at various points. Thus there are muscles to shorten and thicken the trunk, muscles to narrow and lengthen it, and muscles to bend it to any side. Moreover, the great number and independence of these muscles allow of one portion being bent to the right while another is bent to the left, and so on. It is said that there are 30,000 to 40,000 separate muscles in the whole organ. The tip of the trunk has a prehensile and muscular finger.

The trunk of the elephant plainly represents the nose united to the upper lip. In some other quadrupeds, *e.g.*, the elephant-shrew of Africa, the nose is drawn out in almost the same proportion as in the elephant, but here it is the cartilages of the nose which are prolonged, while in the elephant the cartilages have no very unusual development, but an immense addition of muscular and membranous tissues is made to the extremity of the proper nose. The snout of the tapir has somewhat of the same structure as that of the elephant, though it is but slightly developed in comparison. The muscular and membranous elements in particular are greatly foreshortened.

The primary function of the proboscis in the elephant is obviously to bring food to the mouth. The short neck does not allow the mouth to reach the ground while the animal stands erect. Why should the neck be so short? Because it is loaded with heavy tusks and grinders. The tusks alone have been known to weigh 300 lbs. If we try to imagine a long-necked elephant, we are compelled to clothe its neck with an absurdly copious mass of muscle and ligament. The great bulk of the animal magnifies out of all direct proportion the mechanical difficulty of supporting the head. (See an article on "Some Effects of Difference of Size," SCIENTIFIC NEWS, vol. i., p. 202.) The true sequence seems to be—(1) heavy teeth and tusks in an animal of gigantic bulk; (2) short neck; (3) proboscis, long enough to reach the ground.

The attachment of the muscular roots of the proboscis requires an unusual extent of cranial surface, and the forehead of the elephant is of necessity immensely wide and high. But the brain is by no means large in proportion. A rough estimate shows that the elephant's brain weighs only about 1-1,000th of the total weight of the body, whereas in a harvest mouse the proportion is 1-20th. So rapidly do the strength and weight of the driving machinery increase with increased bulk! Although the elephant's skull must be unusually extensive externally, its internal cavity is only of moderate size, far below the proportion obtaining in small quadrupeds. This disparity between the external and internal surfaces of the skull is reconciled in an interesting way. Were the intermediate space to be filled with ordinary bone, the elephant's skull, which (exclusive of the tusks and teeth) already weighs something like 200 lbs., would become, at a guess, nearly as heavy again. In place of solid bone, a number of large air-cells, separated by slender walls of bone, occupy the interval between the inner and outer tables of the skull. It is interesting to notice in a divided skull how the direction of the thin partitions is varied, so as to offer the most effective resistance to pressure at every point, without an atom of needless substance.

A number of observers with good opportunities, and presumably competent, such as Sir Emerson Tennent, Gordon Cumming, and others, have described the power which the elephant possesses of ejecting large quantities of water from the trunk. Sir E. Tennant represents that this is accomplished by placing the proboscis in the mouth, and thence withdrawing gallons of water. Where the water comes from, and how it is regurgitated, are questions upon which anatomy throws hardly any light. The cardiac end of the stomach, it is true, exhibits a number of transverse folds, which have been supposed to act as valves, shutting off a special water-chamber, and the late Dr. Harrison, of Dublin, many years ago described a special muscular apparatus, which he thought might aid the stomach in regurgitating a portion of its contents into the æsophagus. But more recent observers, such as Professor Morrison Watson (*Journal of Anatomy*, 1871), and Miall and Greenwood ("Anatomy of Indian Elephant"), find nothing which can be called a cardiac water-chamber, nor yet any special muscles for emptying it. There is, indeed, at the back of the mouth, a pouch capable of holding a small quantity of water, perhaps a quart or two. All the rest must (it would seem) be sucked up directly from the stomach into the trunk, which is probably sufficiently capacious, when distended, to lodge several gallons of fluid. It is much to be desired that naturalists who have access to elephants living under tolerably natural conditions would clear up the difficulties of this curious subject. Can it be ascertained how much water the trunk alone is capable of lodging? Is certain proof to be had that water is returned from the stomach? There are still unsolved questions of great interest connected with the physiology and habits of the elephants, and there is room for fear that these visibly declining species may become extinct before science has completely satisfied her curiosity respecting them.

POISONS IN THE WORKSHOP.

(*Concluded from p.* 110.)

An exceedingly deadly substance largely employed by electro-platers, and used also to a considerable extent in photography, is the cyanide of potassium. This substance is a solid body of a white or whitish colour, very easily soluble in water, and giving off a powerful and very peculiar odour, which is decidedly poisonous, and produces headaches and other disturbances of the nervous system. Hence all workrooms where it is used or stored in quantity should be well ventilated. In the state of solution it gives off its noxious vapours more freely. Those who have to deal with such solutions should allow them to come in contact with the hands as little as possible, especially if there is any cut or abrasion of the skin. Solutions of cyanide on exposure to the air quickly turn of a brownish colour. We have it on good authority that a workman in an electro-plating establishment at Sheffield had on the table before him two jugs, one containing a solution of cyanide of potassium and the other partly full of beer. Feeling thirsty he took up the wrong jug and swallowed a hearty draught of the deadly fluid before he found out his mistake. In spite of the almost instant attention of three medical men, he was dead in less than twenty minutes. This case emphasizes the rule that no article of food or drink should ever be kept or consumed in any room where poisons are manufactured or used.

Such instantaneously fatal cases are of course rare. But the health of workmen who continually inhale the fumes of this cyanide is always more or less affected.

We must now turn to the coal-tar colours and inquire whether these dyes are found to produce effects upon their producers and users similar to those which are sometimes found to result from wearing garments dyed with such colours? Our own experience, by no means trifling, gives a decidedly negative reply. We have never seen a case of illness which could, with even the remotest probability, be suspected as being due to the manufacture, the dissolving, mixing, etc., or to dyeing and printing with them. We are happy, however, to reinforce our observations with the much wider observations of Dr. Grandhomme. This gentleman has for some years acted as inspecting physician of the celebrated coal-tar colour manufactory belonging to Messrs. Meister, Lucius, and Brüning, at Hoechst. This establishment presents opportuities for studying the subject not, perhaps, to be met with elsewhere. There are a thousand workmen employed in addition to forty foremen and managers, twenty-five chemists, one engineer, and thirty clerks. Each class of colours is prepared in a distinct workroom, and a stringent rule provides that no man shall enter any department save his own. Hence the risk of error in assigning any illness to a wrong cause is practically eliminated. The ventilation is admirable, and every apparatus giving off hurtful gases is placed in connection with the chimney. Rooms containing combustible or explosive substance are illuminated solely by the electric light.

A capital point is the exclusion of arsenic. The magenta employed is made on the Coupier process, and consequently both this colour and all that are further prepared from it are absolutely non-arsenical. Thus their physiological action, whatever it might prove, could not be complicated by the effects of arsenic.

Some of the primary materials from which colours are prepared are undoubtedly poisonous. Benzol has repeatedly proved fatal to all lower animals to which it has been given. If the vapour is inhaled by man, it gives rise to irritation of the brain, dizziness, ringing in the ears, nausea, and drowsiness. Only one serious case is on record, which, however, did not terminate fatally. It is, however, very probable that the constant or frequent breathing of this vapour must have a debilitating effect.

Nitro-benzol, the intermediate step between benzol and aniline, is more formidable. It produces difficulty of breathing, dizziness, drowsiness, and convulsions, death often occurring from general paralysis. Remarkably enough, these symptoms sometimes do not set in until twenty-four hours have elapsed. Forty-four cases of acute poisoning in human subjects, due to contact with this substance, have been observed, of which fourteen proved fatal.

Aniline itself is also a well-recognised poison, whether in its pure state or as the "aniline oil" of commerce. According to circumstances, it may produce either acute or chronic poisoning.

We shall, perhaps, call forth the scepticism of our readers if we say that the *pure* salts of rosaniline, *e.g.*, magenta if only free from arsenic, as well as the derivatives of rosaniline, such as aniline blue, violet, and green, are harmless! Such, however, is indisputably the case. The men employed in the magenta-house have good health, and on frequent and careful examination they have been found free from those affections which magenta was suspected to bring on. It has also been administered to animals, and medical men have experimented on themselves, but without result. Dr. Grandhomme considers that the irritation of the skin occasioned by wearing stockings dyed with magenta has been due to the presence of arsenic.

The manufacture of the lovely colours, eosine and erythrosine, seems injurious. Though these colours, when administered to animals, produce no symptoms of disease, yet the health of the workmen in the eosine-house was not satisfactory. Of the seventeen persons employed in this department, sixteen were annually on the sick-list for a longer or shorter time. A curious effect produced is violent perspiration of the hands, sweat rolling down in drops from the tips of the fingers.

Upon the whole, however, it may be considered that the manufacture and use of the coal-tar colours are not specially dangerous employments. But from all this it does not follow that such colours, even non-arsenical, can be safely worn in immediate contact with the skin. Certainly many stories of "blood-poisoning" (!) from the use of garments dyed with aniline colours are merely *canards*. Sometimes, on rigid scrutiny, both the alleged victim and his or her medical adviser are found to be non-existent. Sometimes the cause of the mischief is said to be some colour which is not in the market at all. Still we should recommend our readers, as far as may be possible, to eschew the present rage for dyed under-clothing.

We have thus briefly surveyed the manufactures most dangerous to public health. There are not a few others, less important, which space does not allow us to take into consideration.

ITALIAN EXHIBITION.—This exhibition closed on Wednesday, Oct. 31st. The exhibition has proved so attractive that it is in contemplation to present a further display of the arts and industries of Italy next year.

Reviews.

Papers and Proceedings of the Royal Society of Tasmania, for 1887. Hobart: Mercury Office.

Among the more noteworthy papers in this volume is one by R. M. Johnston, F.L.S., raising the question "How far can the general death-rate for all ages be relied on as a comparative index of the health or the sanitary condition of any community?" He concluded that while the total death-rate for all ages may be used locally as a fairly trustworthy index of the health and the sanitary condition of any given place from year to year, it is a most fallacious index as regards the comparative health and sanitary condition of different localities.

Mr. W. Saville Kent, F.L.S., discusses the acclimatization in Tasmanian waters of the true salmon (*Salmo salar*), and an epidemic said to have occurred at the fish-breeding institution at Plenty. The disease in question is one too well known in England and Scotland, and is due to the parasitic fungus, *Saprolegnia ferox*. For this disease, temporary immersion in sea-water is recommended. Hard waters, caustic alkalies, and other chemical agents seem to favour the spread of the disease. Perhaps it would be well if waters which have been used in washing sheep were kept out of the rivers.

There are a fair number of botanical and zoological papers, but as these consist for the most part of the description of species, they are not well suited for notice in our columns. We may here except certain papers by Colonel W. V. Legge, F.Z.S., namely, "A First List of the Birds of Maria Island," the "Highlands of Lake St. Clair," and the "Breeding of some Sea-birds on the Actaeon and Adjacent Islands."

Primary Methods in Zoology Teaching, for Teachers in Common Schools. By W. P. Manton, M.D. Boston: Lee and Shepard.

The reader who is sanguine enough to hope that this "jumble of comparative anatomy and physiology," to use the author's candid phrase, will qualify him to teach the subject, is doomed to disappointment. A book so slight and hasty is insufficient even to guide the first steps of the learner—it is a mere extempore effusion of amateurish notions. The excellent manuals of Huxley, Parker, and Morse show a better way to that knowledge which must be possessed by every teacher of zoology who would not be a humbug. We are sorry to say that we can find no merit or usefulness in Dr. Manton's little book. The illustrations, which are "purposely crude," are also ill-selected and ill-drawn.

Star Atlas, containing Maps of all the Stars from 1 *to* 6·5 *Magnitude between the North Pole and* 34° *South Declination, and of all Nebulæ and Star Clusters in the same region which are visible in telescopes of moderate power.* With explanatory text by Dr. Hermann J. Klein. Translated and adapted for English readers by Edmund McClure, M.A., M.R.I.A. London: Society for Promoting Christian Knowledge. Price 7s. 6d.

This atlas contains eighteen maps, printed by E. A. Funke, of Leipsic. The first twelve are beautifully clear and exquisitely engraved star charts. The remaining six maps contain a reproduction of the Brothers Henry's photograph of the star cluster of the Pleiades, and various other nebulæ and star clusters, all marvels of typography. There is also a well-written introduction containing some useful tables, and a description of the more interesting fixed stars, etc., contained in the maps. We can strongly recommend this atlas to those of our readers who are interested in astronomy.

RECOGNITION OF HUMAN BLOOD.

THE diagnosis of human blood, as distinguished from that of the lower animals, is often an important point of criminal jurisprudence, when blood-stains on garments or weapons are laid before the courts as evidence.

This difficult question has lately been discussed in the *Journal of Comparative Medicine*, by Dr. H. Formad.

For deciding the general question whether a certain stain is due to blood or to some vegetable juice or artificial dye the spectroscope and various chemical reagents come into play. But to prove that a given specimen of blood is human or otherwise the microscope alone is of any value, and the sole method in which it is applicable is to measure the blood-cells. The distinction of the blood of any mammalian animal from that of the lower classes of animals is easy, from the fact that in mammalia only the cell is round and non-nucleated. The distinction between the blood of man and that of the lower mammalia turns entirely upon the micrometric measurement of the cells.

The following animals only have blood corpuscles larger than man, *i.e.*, exceeding $\frac{1}{3200}$ of an inch: the elephant, the great ant-eater, walrus, sloth, platypus, whale, capibara, and (according to Wormley) the opossum. Animals whose blood corpuscles are slightly below those of man in size, they having corpuscles from $\frac{1}{3500}$ to $\frac{1}{3000}$ of an inch in size, are the seal, beaver, musk-rat, porcupine, monkey, kangaroo, wolf, and guinea-pig. None of these are domestic animals. All other animals, including all domestic species, have blood corpuscles of a mean diameter less than $\frac{3}{3500}$ of an inch, and, in fact, those animals to which blood-stains found on the clothing of criminals are commonly ascribed, such as the ox, pig, horse, sheep, and goat, have corpuscles with a mean diameter less than $\frac{1}{4000}$ of an inch.

The question may, however, be raised whether the blood corpuscules of *all* mammalian species have been examined with sufficient care. It is very possible that the animals here lumped together under the name "monkey" may have blood-corpuscles not alike in size. Especially is this the case with the anthropoid apes.

Dr. Formad summarises the facts as at present known, as follows:—

1. The blood-corpuscles of birds, reptiles, and fishes, being oval and nucleated, can never be mistaken for human blood.

2. Fresh human blood cannot be mistaken, under the microscope, for the blood of any animal whose corpuscles have a mean diameter of less than $\frac{1}{4000}$, or even $\frac{1}{3600}$ of an inch.

3. (*a*) If the average diameter of the corpuscles in fresh blood be less than $\frac{1}{4000}$, then it cannot possibly be human blood; (*b*) if the diameter be above $\frac{1}{3500}$ inch, then it *may* be human blood; (*c*) if the blood corpuscules, after exhaustive measurement, give a mean diameter exceeding $\frac{1}{3300}$ of an inch, then it *is* human blood, provided it is not the blood of any of the wild beasts mentioned.

These conclusions apply especially to fresh blood. Dried blood, it is asserted, can be distinguished with equal accuracy, provided it has been dried rapidly. If it has dried slowly it will have undergone decomposition, and its structure cannot be made out. A good liquid for moistening dried blood is Virchow's solution, consisting of thirty parts caustic potash and seventy parts water. At least five hundred measurements should be made in order to arrive at certainty as to the average diameter of the cells.

If the corpuscles have become spheroidal from the absorption of moisture, or crenated from drying, they may still be distinguished, because such changes are the same in the corpuscules of all animals, and have their proportionate and corresponding ratio of alteration in form and decrease in size, the range or scale of decrease being always alike in the same animal.

The red blood corpuscules which have become spherical by imbibing liquid have, according to Dr. Formad's observations, the following mean diameters in different species: man, $\frac{1}{4300}$ inch; guinea pig, $\frac{1}{4500}$ inch; wolf, $\frac{1}{4600}$ inch; dog, $\frac{1}{4800}$ inch; rabbit, $\frac{1}{4900}$ inch; ox, $\frac{1}{5600}$ inch; sheep, $\frac{1}{6700}$ inch; goat, $\frac{1}{8100}$ inch.

These figures prove that the diameter of the corpuscles in each animal, when rendered artificially spherical is about one-third less than that of the normal biconcave or disc-like corpuscles of the same animal.

Dr. Formad believes that human blood can thus be positively distinguished from that of any other animal. Other eminent microscopists do not feel equally satisfied.

MICROSCOPIC MANIPULATION.

THE remarks which follow are intended for workers who have had some practice in the simplest modes of preparing and mounting microscopic objects. They form a sequel to the article "How to Work with the Microscope," already published in the SCIENTIFIC NEWS, (vol. i., N.S., p. 82).

Let us suppose that some animal tissue is to be prepared for microscopic examination. It is a good plan to procure a small mammal, and remove from the fresh-killed body a number of different tissues, say, stomach, small intestine, a large nerve, such as the sciatic, and a piece of spinal cord. These should be placed immediately in the hardening fluid. Only small pieces which can be rapidly penetrated by the fluid should be taken. No part of the object should be more than $\frac{1}{8}$ in. from the surface. The fluid should be greatly in excess of what is required to cover the tissues; thus four or five small bits may be placed in about four ounces of fluid. Trim the tissues to such shapes that by merely looking at them you can see how they lay in the body and how they must be cut. For instance, the long axis of the piece may correspond to the long axis of the organ, the narrow end of the piece to the narrow end of the organ, and so on.

Procure from the chemist 6 oz. of 10 per cent. solution of chromic acid, and keep it by you in a stock bottle. Dilute some of this to $\frac{1}{3}$ per cent. for ordinary use as a hardening fluid. Various other solutions possess special advantages of their own, but it is of the first importance not to be bewildered by a multiplicity of reagents, and the beginner will do well to have only one process in his mind, until he has thoroughly mastered it. The solution should be changed after 24 hours, and then allowed to act for several days (2 to 14, according to the size of the tissues).

Avoid as far as possible all fingering or pulling of the parts. Epithelium, in particular, must never be rubbed, however lightly. Wide-mouthed stoppered bottles are used in all the operations with fluid; those which have contained chromic acid must be scrupulously washed with strong mineral acid and water before they are used for any other purpose.

The next step is to remove all free chromic acid, and gradually to dehydrate the tissues. Different strengths of alcohol are employed. Buy a gallon of methylated alcohol of good strength, and a few ounces of absolute alcohol. The methylated alcohol should contain 80 per cent. of spirit. Mix it with water so as to get a 40 per cent., and also a 60 per cent. solution. Then remove the tissues from the chromic acid, add to them a small quantity of 40 per cent. alcohol, pour this away, and add a relatively large quantity of the same. After 24 hours change to 60 per cent., and renew the fluid once or more, according to the size of the tissues and the amount of colouration of the alcohol. Then change to methylated alcohol of full strength. If the tissues are not immediately wanted, keep them in methylated alcohol. Too long soaking in absolute alcohol renders them brittle and over-contracted. The gradual saturation with strong alcohol should occupy about a fortnight. Note that waste alcohol should be kept for redistillation.

All is now ready for staining. Here, again, it is best to practise one method only until proficiency has been gained. Begin with alcoholic borax-carmine, and stain the tissues whole before cutting. The staining fluid is made in this way: Take a 4 per cent. solution in water of borax. Saturate with carmine (2 to 3 per cent.), leaving the mixture to stand for a day or two, and stirring now and then. Add an equal bulk of methylated alcohol. Let the solution stand for a week, and then filter.

Place the tissues in perfectly clean bottles, with enough of the staining fluid to cover them. Leave them for two or three days, then pour off the fluid, and add methylated alcohol, slightly acidulated (two drops of hydrochloric acid to the ounce). The crimson stain is thereby fixed, and brightened in colour. Transfer once more to ordinary methylated alcohol, and just before cutting to absolute alcohol for twenty-four hours.

Most tissues require imbedding to give sufficient firmness. For cutting by hand nothing is better than cacao butter. Make a small rectangular paper tray, about 1 in. long, $\frac{1}{2}$ in. wide, and $\frac{1}{2}$ in. deep. Fill this with the melted cacao butter, dry the tissue superficially, and place in the tray. Take care that it is completely immersed in the butter, and don't heat the butter more than is absolutely necessary. When the preparation is cold remove the paper, and pare down the block with a sharp knife. It is undesirable to have to cut through much of the imbedding substance with the razor, and equally undesirable to weaken the block too much. The top of the block must therefore be trimmed so as to slope away on all sides, and the operation must be repeated frequently as cutting proceeds. To prevent melting in the hand hold the block in a piece of paper. Use the sharpest razor you can obtain, wet the blade and also the tissue with methylated alcohol, pick up the sections as cut with a small camel-hair brush, and transfer to a watch-glass of methylated alcohol. When a sufficient number have been obtained pick away and remove the chips of imbedding substance with a needle and brush, replace the methylated alcohol by absolute, and this again by oil of cloves. Finally pick out the sections one by one with a section-lifter, and mount in balsam.

Where a mechanical microtome is required Fearnley's may be recommended. It is good and cheap, and admits of imbedding either in a waxy medium or in celluloidin. Special instructions are required for this or any other mechanical microtome. Caldwell's rocking microtome is indispensable where many consecutive sections are required, but it is not well adapted to the wants of the beginner. It is somewhat costly, and the necessary appliances, to say nothing of the continuous time required by the different operations, presuppose serious devotion to biological work. Hand-cutting will do a great deal, and no microtome can altogether replace it. The novice will therefore do well to give his principal or sole attention to hand-cutting for at least the first few months of his initiation.

THE ACTION OF MICROBIA UPON COLOURING MATTERS.

THE following memoir has been submitted to the Paris Academy of Sciences by its author, M. J. Raulin:—

If we colour wort in alcoholic fermentation with magenta, Nicholson blue, imperial violet, saffranine or Poirrier orange No. 2, a part of the colouring matter is seized upon by the yeast and dyes it strongly, whilst cochineal, logwood, orchil, and extract of indigo do not dye it. In the former case we have a true tinctorial action analogous to that which the same colouring matters exert upon animal fibres.

The spores of *Aspergillus niger* have been sown in artificial liquids suitable for cultivation, one containing nitrate of ammonia; a second, a salt of aniline; a third, a salt of rosaniline; a fourth, extract of indigo; the fifth being entirely free from nitrogen. The mould flourished well in the first liquid, but gave merely an insignificant yield in the four others. It will be remembered that M. Pasteur has found moulds able to assimilate the nitrogen of ethylamine, and that M. G. Ville has observed large plants assimilating the nitrogen of ethylamine and methylamine. Are these differences of action connected with the differences of constitution of compounds belonging respectively to the aromatic and to the fatty series?

Yeast-water, beer-wort, or an artificial sugary liquid, slightly acidified if tinted with extract of indigo, are slowly and progressively decolourised in a few days in the absence of any organism, but in presence of air. This is an oxidation, since carbonic acid gas hinders the decolouration. Certain ærobic organisms, such as *Aspergillus niger*, *Mycoderma vini*, *Mycoderma aceti*, hinder or retard this decolouration by opposing the access of oxygen. Active beer-yeast produces the same effect; still, after some weeks, beer-wort in active fermentation by means of ordinary brewers' yeast, if tinted with extract of indigo, is decolourised in the absence of atmospheric oxygen, but this is a reduction by hydrogenation, for the colour reappears on the contact of air, and this reduction coincides with the development of microbia, similar to the lactic ferment.

To render this decolouration of extract of indigo by reduction as certain and as rapid as possible, the yeast-water is left to itself for some days at a temperature of about 75° Fahr. It is then full of bacteria, and gives off a putrid odour. The bacteria increase rapidly if they be sown in fresh yeast-water.

If such yeast-water be coloured with extract of indigo, this is decoloured more or less rapidly. A quarter of an hour suffices in the most favourable cases. In a few hours we may thus reduce 500 milligrams of dry extract of indigo in 1 litre of liquid. This decolouration is so much the more rapid as the microbia are more numerous. On the other hand, heat and antiseptics such as phenol (which kills the organisms) oppose the decolouration. Filtration renders the filtrate inactive, whilst the liquid remaining upon the filter retains its activity. The decolouration, therefore, is not the result of the action of a substance previously generated by the microbia, which would accumulate in the liquid, unless we suppose that heat, antiseptics, and atmospheric oxygen introduced by filtration destroy this substance—an inadmissible hypothesis, since on saturating the unfiltered liquid with oxygen we do not destroy the faculty of decolouration. This power of the microbia is therefore an actual action, direct or indirect, inherent in their life. It is a reductive action, since the indigo resumes its colour on exposure to the air, and the bacteria themselves are anærobic.

We must not confound this phenomenon with the decolouration of extract of indigo in an alkaline solution of glucose, for in the latter case the microbia are not necessary, and in the former the decolouration still takes place in a neutral or slightly acid medium. It is not due to hydrogen set at liberty, for its quantity is quite insufficient to explain the result.

This phenomenon is doubtless connected with the special mode of respiration of these organisms.

M. Duclaux has observed the decolouration by reduction of extract of indigo in milk, making its appearance at the same time as the first organisms, and M. Dubois has observed the spontaneous decolouration of litmus in closed vessels, as due to a kind of micrococcus.

It is not alone upon extract of indigo that these microbia exert their activity by hydrogeneration. Logwood, orchil, saffranine are decolourised rapidly, though less so than extract of indigo, and resume their colour on exposure to air. Certain azo-colours, such as the ponceau 3R of Meister, Lucius and Brüning, the orange No. 2 of Poirrier and Bordeaux red, are decolourised rapidly, but do not recover their colour in the air. Nicholson blue and imperial violet are decolourised in a few days, but magenta, cochineal, and the colouring-matter of wine resist for some weeks. Hence the microbia in question may prove useful reagents for foreign colouring-matters added to wine.

Abstracts of Papers, Lectures, etc.

SOCIETY OF ENGINEERS.

At a meeting of the Society of Engineers, held at Westminster Town Hall on the 5th November, Mr. A. T. Walmisley, President, in the chair, a paper was read on "The Practice of Foundry Work," by Mr. H. Ross-Hooper.

The paper first briefly compared the particular qualities and properties of pig iron, with the view of determining the varieties which are best adapted to the requirements of the different kinds of castings made; and showing how the nature of cast-iron depended not only upon the amount of carbon that it contained, but upon the conditions under which that carbon existed. The author then proceeded to illustrate how the failing of portions of a cast-iron structure may be traced to a want of knowledge in the way the lines of crystallisation flow on the cooling of the metal, and mentioned the weak points to be guarded against in the designing of cast-iron work. Moulding or the production of a hollow mould to receive the metal was next considered; for to mould melted iron into any required shape or form two things are necessary—(1) a pattern of the article to be produced, (2) a substance which will retain the impressions of the pattern made upon it and resist the violence of the metal when poured therein. To make a pattern a man requires to be thoroughly conversant with the principles of moulding, to so construct it that it may give a minimum of trouble to the moulder; the materials used for pattern making and the general essential points of this branch being touched upon. The differences between green and dry sand moulding, the requisites of a good foundry sand, and the mode of preparing a mould for a small girder bed-plate were entered into in detail, noticing those particulars which should be observed in the construction of sand moulding, and showing the uses of cores and the method employed in their formation both large and small.

The author next proceeded to describe the features of loam moulding, illustrating (by means of a working model) the process of constructing a mould for a drum capable of holding 200 feet of one-inch wire rope used in the erection of the Sukkur Bridge, India.

After explaining the operations of chill casting, malleable cast-iron, and the system of moulding known as "Jobson's Blocks," whereby sand moulds of thin delicate patterns can be made by ordinary labourers, the author mentioned the different modes adapted for casting according to the forms and requirements of the various articles to be produced, and how sound results can only be obtained by a careful attention paid to the feeding of the metal to supply the shrinkage and drawing away which must inevitably occur on the cooling of the metal. The cupola, its construction, and advantages over other types of furnaces, and the manner of charging it, together with the appliances necessary to a foundry in the shape of drying stoves, laddles, cranes, etc., and a "fettling shop" for the ultimate cleaning and dressing of castings were duly considered.

The author then treated of the examination of cast-iron work and the care that should be observed in all inspection of the same, and finally discussed the tests usually applied and the general strength of cast-iron.

LEEDS GEOLOGICAL ASSOCIATION.

At the meeting on Oct. 25th, Mr. J. E. Bedford, F.G.S., the President, delivered an address on "The Oil Fields of the United States and Russia." There are now, he said, two large centres from which petroleum products are derived—the State of Pennsylvania, in the United States of America, and the district of Baku, in Southern Russia. To the Americans is due the credit of having developed an enormous trade and of benefiting the world at large. Paraffin is the most generally known product of the petroleum industry. It is obtained by distillation of the crude petroleum in large retorts or stills. When the heat rises to the boiling point the distillation commences, and the lighter spirit or gasoline, generally called benzoline, is the first product. When this is all gone, the heat of the still is increased, and paraffin distils over, and is collected separately. The distillation is then continued at a higher temperature, when other oils of a higher specific gravity are produced. These oils are too heavy for burning in lamps; the temperature at which they vaporise being very high, they will not burn on a lamp wick. This oil has good properties, which have been utilised in another direction. As a lubricating material for steam cylinders it has no equal. Having no action on metals, and being stable at a high steam heat, it is very much superior to tallow or vegetable oil for this special purpose. Another bye-product in the paraffin industry which has recently come into extensive use is vaseline—a semi-solid paste, which, when purified, has a fine amber colour, and is used for dressing wounds, and for the bases of ointments and pomades. As it is one of the paraffin series it never becomes rancid, as all animal and vegetable fats do, by the separation of the fatty acid from the glycerine. No doubt all petroleum districts will show evidence of the presence of the oil by exudation on the surface or by the oil being brought up by springs of water. In order to obtain the oil in large quantities, bore-holes are made and carried deep enough to reach the oil-bearing strata. This is generally sufficient for a fairly constant flow of crude oil. There is often pressure sufficient for the oil to be spouted into tanks without pumping. It is then conveyed to the refineries either by special railway tanks or by lines of iron pipe. Many of the latter are several miles in length. Petroleum is now being largely used for fuel in place of coal. The Standard Oil Company of Cleveland, Ohio, have constructed a pipe line 207 miles long, stretching from Lima to South Chicago. The pipe is 8 inches in diameter. There is a powerful pumping engine at Lima, and this forces the oil all the way to Chicago, where a steady stream issues, amounting to 5,000 barrels a day. The company have reservoirs into which the oil is run, and they supply great quantities to the ironworks of the district. There is great difference in the geological age of the strata in which oil and gas are found. In Ohio, Kentucky, Virginia, and Tennessee the oil has its origin in sandstones or shales of Devonian age, or in the Trenton limestone of the Lower Silurian. In describing the Wyoming oil region, Mr. Bedford quoted from Professors Aughey and Ricketts, who state that the cretaceous rocks are the best developed, and the most important of the whole series. They are from 5,000 feet to 6,000 feet thick, and are divided into four groups—the Dakota, Colorado, Fox Hills, and Laramie. They consist mainly of a coarse conglomerate, firmly cemented; porous sandstones and sandy shales, but no limestone. Every one of those groups has oil springs, or contains strata whose outcrops are saturated with oil. With one single exception, no petroleum occurs (in this district) in any other than cretaceous rocks. The exception is the Schoshone oil, which is found at a lower horizon, namely—at or near the bottom of the Triassic or the top of the carboniferous formation. Thus in the Eastern States the oil is found in Silurian and Devonian strata, and in the Western States it lies in the cretaceous rocks. The names of these beds are local, and sound somewhat strange to English geologists; they, however, are similar in their fossil remains to a great extent, and will correspond with those of our wealden, upper and lower greensand, and chalk. Passing now to the Russian oil-fields, it may be said that the method of production by boring is the same as in America, but the yield is still greater. The petroleum has been worked commercially since the Russians annexed the district in 1801. Formerly a monopoly existed in this trade, but upon its abolition several companies were established, and an enormous production has resulted. There are between 400 and 500 wells drilled in the Baku district, about 100 of which yield a supply, only some twenty of these being flowing wells. These are all comparatively close together, and occupy a space of land not more than 3½ miles square. One of these wells spouts a jet of oil into the air amounting to a million gallons in twenty-four hours. Petroleum is largely obtained in other parts of the Caspian district. Mr. Bedford gave a very interesting account of the boring operations necessary to reach the oil, which have to be taken to a depth of from 300 ft. to 600 ft. As soon as indications appear of oil, which is generally preceded by a rush of gas, a cap is fixed on the top, with valves to control and regulate the flow; for in some cases the oil has come up with such force that it has destroyed everything around. The yield is enormous; the Droojba well sent up two million gallons a day for some time. Messrs. Noble Bros. had one well which spouted thirty million gallons in four weeks. The copious supply at Baku will be understood when it is stated that the single well just described equals in its flow of oil all the 25,000 wells of America put together, and there is yet no sign of any diminution of quantity. The position of Baku is rather unfavourable for the transmission of the oil to the European and Indian markets. It is now sent to Batoum on the Black Sea in railway tanks, and this journey generally takes a week or ten days. It is intended to lay a pipe line to convey it, which will be some 600 miles in length. There are several theories which attempt to account for the formation of petroleum in the rocks. Some great chemists think that it has originated by the union of inorganic elements, that the carbon existing in the strata combined in some way with hydrogen and oxygen. The more generally received opinion is that the oil is the result of the decomposition of animal and vegetable remains, which lived at the time when the rocks were laid down. The evidence seems to point to animal remains as the most likely to yield hydrocarbons. If the oil had been derived from plant life, one would expect to find the fossil plant remains in fair quantity, but this is not so. Coal strata would be expected to furnish oil; but little, if any, is ever found in them. Animal remains are always found in strata yielding oil. The Trenton limestone contains orthoceratites in great quantities, and the cavities often contain several ounces of oil. Hoefer says that all slates which give hydro-carbon oils on distillation are rich in animal remains, while they show few of vegetable origin; and that the rocks which contain large quantities of vegetable remains are not bituminous as a rule, but become so when animal remains are also present. The fact of salt water being so often present with petroleum also points to a marine fauna. Supposing that these fossil remains have been subjected to heat and pressure for a great length of time, as they no doubt have, then great chemical changes would occur; decomposition would begin with the nitrogenous portions of the animal (the gelatine, albumen, etc.). The fats not being so easily changed, would remain to a later period and be absorbed by the rocks. These fats are different in chemical constitution from the paraffin series of oils, and further decomposition would be necessary to produce paraffin. The latter are not so complex in the construction of the molecules as organic fats are, being less organised, one might say, and approaching more nearly to carbon compounds of mineral origin. This points to the assumption that the process of dissociation, and the reforming of other compounds, had proceeded until a substance had been formed which refused further chemical changes, and this has resulted in the whole series of paraffins known to chemists.

Australasian Association for the Advancement of Science.—At a meeting of the Council of the Australasian Association for the Advancement of Science, the President, Mr. H. C. Russell, being in the chair, the following motions were carried :—

"That the delegates appointed for the Sydney meeting of the Association be requested to form local committees in their respective colonies. upon the same lines as the local committees of the British Association."

"That the authors of papers be informed that if the papers contributed by them are not published by the Association in full, they are at liberty either to contribute the papers to local societies, publish them in any journal, or dispose of them in any way they may desire."

"That a formal application be made to the Government for a refund on behalf of those members of the Association who paid full fare to travel over the railway lines to Sydney."

The financial statement, which was submitted, showed a credit balance of £230.

Notices were received of the appointment of the following gentlemen to the general council :—Mr. F. G. A. Barnard (Field Naturalists' Club, Victoria); Professor H. M. Andrew, M.A. (Melbourne University Science Club); Mr. A. Purchase, C.E. (Institute of Architects, Victoria); Mr. A. O. Sachse, C.E., F.R.G.S. (Victorian branch of the RoyalGeographical Society of Australasia).

London Mathematical Society.—At the meeting held on November 8th (Sir J. Cockle, F.R.S., President, in the chair), the President, in a few well-chosen and touching sentences informed the members present of the loss the Council and the Society had sustained during the recess by the decease of Mr. Arthur Buchheim. After the election of the Council, the new President (Mr. J. J. Walker, F.R.S.) took the chair, and called upon the retiring President to read his address on "The Confluences and Bifurcations of Certain Theories." The following further communications were made :—"On Cyclotomic Functions §1 Groups of Totitives of n; §2 Periods of nth Roots of Unity," Prof. Lloyd Tanner; "On a Theory of Rational Symmetric Functions," Capt. P. A. MacMahon, R.A.; "The Factors and Summation of $1^r + 2^r + \ldots + n^r$," Rev. J. J. Milne; "Raabe's Bernoullians," Mr. J. D. H. Dickson; "Certain Algebraical Results Deduced from the Geometry of the Quadrangle and Tetrahedron," Dr. Wolstenholme; "On a Certain Atomic Hypothesis," Prof. K. Pearson; "On Deep-Water Waves Resulting from a Limited Original Disturbance," Prof. W. Burnside.

Liverpool Geological Association.—At the monthly meeting of this Association held on November 5th, Mr. Percy F. Kendall, of Owens College, Manchester, delivered a lecture on "The Geology of Mull," in the course of which he said: To a geologist the history of Mull was the history of a volcano. In no other part of the British Isles were the results of long-continued volcanic action so clearly visible as in this outlying region of Western Scotland. There, what had once been a volcano, rivalling Etna or Teneriffe in magnitude, had been acted upon by denuding forces until it was laid open to its very core. The granitic rocks and representative acid larvas and tuffs of the earlier stages of volcanic activity were seen to be penetrated and overlain by the basic larvas of a later stage; while the fragmental rocks formed during the clearing of the volcanic chimney, and the intricate system of dykes and intrusive sheets incidental to the building up of a great volcanic cone, were clearly exposed to view. The work done during each stage of volcanic activity was then ably sketched by Mr. Kendall, who indicated what conclusions might be drawn from the distribution of products, and the arrangements of the dykes. The energy of the underground forces seems to have culminated in the Miocene period, when floods of basaltic lava were poured out of the vent, deluging the country for miles round. It was owing to a happy accident in this period that the inundation of a certain valley by a mass of lava resulted in the preservation of the Mull leafbeds, the mud in which the leaves were imbedded having been preserved to our own day, thanks to its hard capping of igneous rocks.

St. John's Natural Science Society, Upper Holloway.—On November 2nd this rising Society held a very successful conversazione in the gymnasium attached to St. John's Institute.

Amsterdam Royal Academy of Sciences.—At the ordinary meeting of the Physical Science section on Saturday, 27th October, M. Behrens read a paper which treated of the manner in which the volcanic lakes in the Eifel mountains originated, and demonstrated that they could not owe their origin to the crumbling down of extinct volcanoes. From experiments made by the author, he rather concluded that the Eifel Lakes must be regarded as incomplete volcanoes, formed by the softening and continuous blasting of the sedimentary rocks, only a little lava being brought to the surface.

THE FOUNDATION-STONES OF THE EARTH'S CRUST.

An Evening Discourse delivered by T. G. Bonney, D.Sc., LL.D., F.R.S., F.G.S., etc., before the British Association, on September 10th, 1888.

(Continued from p. 464.)

On the other side what evidence can be offered? In the first place, any number of vague or rash assertions. So many of these have already come to an untimely end, and I have spent so much time and money in attending their executions, that I do not mean to trouble about any more till its advocates express themselves willing to let the question stand or fall on that issue. Next, the statement of some of the ablest men among the founders of our science, that foliation is more nearly connected with cleavage than with structures suggestive of stratification. In regard to this I have already admitted, in the case of the more coarsely crystalline rocks, what is practically identical with their claim, for they also assert that when the banding was produced, very free movement of the constituents was possible; and in regard to the rest I must ask whether they were speaking of cleavage-foliation or stratification-foliation, which had not then been distinguished, and I know in some instances what the answer will be. The third objection is of a general nature. To prevent the possibility of misstatement I will give it as a quotation: "To a geologist (especially one belonging to the school of Lyell) it is equally difficult to conceive that there should be a broad distinction between the metamorphic rocks of Archæan and post-Archæan age respectively, as that the pre-Tertiary volcanic rocks should be altogether different in character from those of Tertiary and recent times." Of course in this statement much depends on the sense attached to the epithet "broad." As an abstract proposition I should admit, as a matter of course, that from similar causes similar consequences would always follow. But in the latter part of the quotation lurks a *petitio priucipii.* During the periods mentioned volcanic rocks appear, as we should expect, to have been ejected from beneath the earth's crust similar in composition and condition, and to have solidified with identical environment. Hence the results, allowing for secondary changes, should still be similar. But to assume that the environment of a rock in Early Archæan times was identical with that of similar material at a much later period is to beg the whole question. My creed also is the uniformitarian, but this does not bind me to follow a formula into a position which is untenable. Other studies with which I have some familiarity have warned me that a blind orthodoxy is one of the best guides to heresy. "The weakness and the logical defect of uniformitarianism"—these are Professor Huxley's words—"is a refusal, or at least a reluctance, to look beyond the 'present order of things,' and the being content for all time to regard the oldest fossiliferous rocks as the *ultima Thule* of our science." Now, speaking for myself, I see no evidence since the time of these rocks, as at present known, of any very material difference in the condition of things on the earth's surface. The relations of sea and land, the climate of regions, have been altered, but because I decline to revel in extemporised catastrophes, and because I believe that in nature order has prevailed and law has ruled, am I therefore to stop my inquiries where life is no longer found, and we seem approaching the firstfruits of the creative power? Because palæontology is perforce silent; because the geologist can only say "I know no more," must I close my ear to those who would turn the light of other sciences upon the dark places of our own, and meet their reasoning with the exclamation, "This is not written in the book of uniformity"? To do this would be to imitate the silversmiths of old, and silence the teacher by the cry, "Great is Diana of the Ephesians."

What, then, does the physicist tell us was the initial condition of this globe? I will not go into the vexed question of geological time, though as a geologist I must say that we have reason to complain of Sir W. Thomson. Years ago he reduced our credit at the bank of time to a hundred millions of years. We grumbled, but submitted and endeavoured to diminish our drafts. Now he has suddenly put up the shutters and declared a dividend of less than four shillings in the pound. I trust some aggrieved shareholder will prosecute the manager. However, as a *cause célèbre* is too long a business for the end of an evening, I will merely say that while personally I see little hope of arriving at a chronological scale for the age of this earth, I do not believe in its eternity. What, then, does the physicist tell us must have been in the beginning? I pass by those earliest ages, when, as "Ilion, like a mist, rose into towers," so from the glowing cloud the great globe was formed. I pass on to a condition more readily apprehended by our faculties—the time—the *consistentior status* of Leibnitz—when the molten globe had crusted over, and its present history began. Rigid uniformitarian though you may be, you cannot deny that when the very surface of the ground was at a temperature of at least 1,000 degs. F., there was no rain, save of glowing ashes—no river, save of molten fire. Now is ending a long history with which the uniformitarian must not reckon—of a time when many compounds now existing were not dissolved but dissociated, for combination under that environment was impossible. Yet there was still law and still order—nay, the present law and order may be said even then to have had a potential existence—nevertheless to the uniformitarian gnome, had such there been, every new combination of elements would have been a new shock to his faith, a new miracle in the earth's history. But at the times mentioned above, though oxygen and hydrogen could combine, water could not yet rest upon the ruddy crust of the globe. What does that mean? This, that assuming the water of the ocean equivalent to a spherical shell of the earth's radius and two miles thick, the very lava stream would consolidate under a pressure of about 310 atmospheres, equivalent to nearly 4,000 feet of average rock.* But on the practical bearing of this consideration I will not dwell. Let us pass on to a time, which, according to Sir W. Thomson, would rather quickly arrive, when the surface of the crust had cooled by radiation to its present temperature. Let us, merely for illustration, take a surface temperature of 50° F. (nearly that of London), and assume that the present rise of crust temperature is 1° F. for every 50 feet of descent, which is rather too rapid. If so, 212° F. is reached at 8,100 feet, and 250° F. at 10,000 feet. Though the latter temperature is far from high, yet we should expect that under such a pressure, chemical changes would occur with much more facilty than at the surface. But many Palæozoic or even later rock masses can now be examined which at a former period of their history have been buried beneath at least 10,000 feet of sediment; yet the alteration of their constituents has been small; only the more unstable minerals have been somewhat modified, the more refactory are unaffected. But for a limited period after the *consistentior status*, the increase of crust temperature in descending would be far more rapid; when one twenty-fifth of the whole period from that epoch to the present had elapsed, and this is no inconsiderable fraction, the rate of increase would be 1° for every ten feet of descent. Suppose, for the sake of comparison, the surface temperature as before, the boiling-point of water would be reached at 1,620 feet, and at 10,000 feet, instead of a temperature of 250° F., we should have one of 1,050° F. But at the latter temperature many rock masses would not be perfectly solid.† According to Sorby the steam cavities in the Ponza trachyte must have formed, and thus the rock have been still plastic at so low a temperature as 680° F. At this period then, the end of the fourth year of the geological century, whatever be its units, structural changes in igneous and chemical changes in sedimentary rocks must have occurred more readily than in any much later period

* If we take the S.G. of water as unity, and that of mean rock as 2·7, the pressure would be = 3,911·1 feet of rock.

† The lowest temperature, which, so far as I know, has been observed in lava (basic) while still plastic, is 1,228° F.

in the world's history. A temperature of 2,000° F., sufficient to melt silver—more than sufficient to melt many lavas—would have been reached at a depth of about four miles. It would now be necessary to descend for at least twenty miles, in order to arrive at this zone. It, during the ninety-six years of the century, has been changing its position in the earth's crust, more slowly as time went on, from the one level to the other.

There is another consideration, too complicated for full discussion, too uncertain perhaps in its numerical results to be more than mentioned at present, which, however, seems to me important. It is this, that, in very early times, as shown by Professor Darwin and Mr. Davison, the zone in the earth's crust, at which lateral thrust ceases and tension begins, must have been situated much nearer to the surface than at present. If now, at the end of the century, it is at the depth of five miles, it was, at the end of the fourth year, at a depth of only one mile. Then, a mass of rock, 10,000 feet below the surface, would be nearly a mile deep in the zone of tension. Possibly this may explain the mineral banding of much of our older granitoid rock, already mentioned, and the coincidence of foliation with what appears to be stratification in the later Archæan schists, as well as the certainly common coincidence of microfoliation with bedding in the oldest indubitable sediments.

Pressure no doubt has always been a most important factor in the metamorphism of rocks; but there is, I think, at present some danger in over-estimating this, and representing a partial statement of truth as the whole truth. Geology, like many human beings, suffered from convulsions in its infancy; now, in its later years, I apprehend an attack of pressure on the brain.

The first deposits on the solidified crust of the earth would obviously be igneous. As water condensed, denudation would begin, and stratified deposits, mechanical and chemical, become possible, in addition to detrital volcanic material. But at that time the crust itself, and even stratified deposits, would often be kept for a considerable period at a temperature similar to that afterwards produced by the invasion of an intrusive mass. Thus not only rocks of igneous origin (including volcanic ashes) would predominate in the lowest foundation-stones, but also secondary changes would occur more readily, and even the sediments or precipitates should be greatly metamorphosed. Strains set up by a falling temperature would produce, in masses still plastic, banded structures, which, under the peculiar circumstances, might occur in rocks now coarsely crystalline. As time went on, true sediments would predominate over extravasated materials, and these would be less and less affected by chemical changes, and would more and more retain their original character. Thus we should expect that as we retraced the earth's course through "the corridor of time," we should arrive at rocks which, though crystalline in structure, were evidently in great part sedimentary in origin, and should beyond them find rocks of more coarsely crystalline texture and more dubious character, which, however, probably were in part of a like origin; and should at last reach coarsely crystalline rocks, in which, while occasional sediments would be possible, the majority were originally igneous, though modified at a very early period of their history. This corresponds with what we find in nature, when we apply, cautiously and tentatively, the principles of interpretation which guide us in stratigraphical geology.

I have stated as briefly as possible what I believe to be facts. I have endeavoured to treat these in accordance with the principles of inductive reasoning. I have deliberately abstained from invoking the aid of "deluges of water, floods of fire, boiling oceans, caustic rains, or acid-laden atmospheres," not because I hold it impossible that these can have occurred, but because I think this epoch in the earth's history so remote and so unlike those which followed, that it is wiser to pass it by for the present. But unless we deny that any rocks formed anterior to or coeval with the first beginning of life on the globe can be preserved to the present time, or, at least, be capable of identification—an assumption which seems to me gratuitous and unphilosophical—then I do not see how we can avoid the conclusion to which we are led by a study of the foundation-stones of the earth's crust, namely, that these were formed under conditions and modified by environments which, during later geological epochs, must have been of very exceptional occurrence. If, then, this conclusion accords with the results at which students of chemistry and students of physics have independently arrived, I do not think that we are justified in refusing to accept them, because they lack the attractive brilliancy of this or that hypothesis, or do not accord with the words, in which a principle, sound in its essence, has been formulated. It is true in science, as in a yet more sacred thing, that "the letter killeth, the spirit giveth life."

CORRESPONDENCE.

The Editor does not hold himself responsible for opinions expressed by his correspondents, nor can he take notice of anonymous communications. All letters must be accompanied by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

THE MARTIAN CANALS.

Your recent articles on this subject summarise the observational results in a thorough manner; but the final and theoretical chapter much disappoints me. It may, possibly, have been written a month or two back; if so, the entire omission is explained of what is, in my opinion, the best hypothesis yet advanced—one due to Dr. Eugène Penard, of Geneva.

This first appeared, I believe, in *L'Astronomie* for October, and supposes the canals to be due to inundation of fissures, in the probably thick crust of the planet, produced by its secular contraction. We observe such clefts on a reduced scale in the moon, as well as in the Western States, the Deccan, and the South of France. In the case of the larger canals, we have probably a sinking *en masse* of the slice between two parallel fissures, such as occurs terrestrially in the Rhine Valley. Fractures here, as Daubrée found with glass, etc., would only stop at the edges, or on meeting with other cracks.

To extend this:—In the case of doubles, it is evident that a general sinking between the two clefts would occur but to a lesser extent, and therefore, after flooding, paler in tint. This explains why in August last the Lick telescope showed no duplicate canals, but simply shady bands of the width of the mapped twins.

Why, too, does your contributor dismiss the late Mr. Proctor's diffraction theory with the single argument that rivers do not cross continents from sea to sea? This is not even a terrestrial fact; for the Rhine and the Rhone form an almost continuous waterway across Europe, the Vosges and Jura Mountains preventing a straight course. Other examples might be given. The real and fatal objection is, that eyepieces of different powers have not been found to give distances varying out of proportion to them, as they would in the case of diffraction images.

In *L'Astronomie* for November, the indefatigable editor (M. Camille Flammarion), who furnishes fully half the "copy," gives utterance, in his usual enthusiastic style, to a somewhat lengthy "Last Word on the Planet Mars." In this he carefully reviews all Schiaparelli's recent observations, and finally comes to the conclusion that "the essential features of the Martian geographical configuration do not change." Whilst admitting our knowledge to be as yet insufficient to enable us to theorize, he regards the inundations as due to solar tides, and adheres to the hypothesis that the canals are really rivers, whose straight course is due to the absence of mountains (worn down, possibly, by past denudation), and the rapid precipitation of water in an atmosphere whose pressure is probably much less than ours.

Where seas are, there rivers must certainly be, and, as he points out, the canals always open into gulfs of estuarine appearance, and do not actually pass straight across continents, but end usually in lakes, whence other canals emerge, often at an angle. W. S.

South Kensington, Nov. 10th.

RECENT INVENTIONS.

The following list has been compiled especially for the SCIENTIFIC NEWS *by Messrs.* W. P. THOMPSON *and* BOULT, *Patent Agents, of* 234, *High Holborn, London, W.C ; Newcastle Chambers, Angel Row, Nottingham ; Ducie Buildings, Bank Street, Manchester ; and* 6, *Lord Street, Liverpool.*

THERMOSTAT.—Messrs. C. R. Kinnell and G. Rothnie have patented a thermostat for automatically regulating the supply of gas or liquid fuel employed in heating buildings. The apparatus is in the form of an ordinary thermometer, having the upper portion of the tube divided into parts through which the gas passes. While the temperature remains below a certain degree the tube is open. If the heat exceeds this degree, then the quicksilver in the thermometer rises and enters this tube, thus diminishing or shutting off the gas supply. The temperature having fallen, the quicksilver falls, and the passage for the supply of fuel is again open.

GOLD ORES.—Mr. P. J. Ogle has patented an arrangement of the amalgamated plates used in the treatment of gold ores. The invention consists in employing a series of short amalgamated copper plates, mounted on a series of steps furnished with grooves, in which each plate slides, allowing the water carrying the crushed ore to fall from one to the other, thus bringing the float, or fine gold, into actual contact with the amalgamated plates. This arrangement causes the wash water to be broken up, and the plates being adjustable, a fresh surface of mercury can be presented to the wash water as soon as the working surface is inactive through saturation.

GASES IN MINES.—Mr. F. Bosshardt has patented an apparatus for detecting and announcing the presence of explosive gases in mines, on behalf of J. Molas. The apparatus consists in the combination of a diaphragm furnished with silver strips inside a chamber with a suitable number of terminals, in such a manner that on undue accumulation of gases entering the chamber the diaphragm is lifted and forms a contact between the silver strips and the terminals, thus causing a simultaneous and automatic ringing of alarm bells, and the lighting of an incandescent lamp through suitable electric connections.

ELECTRIC BATTERIES.—Mr. D. Urquhart has patented a process for the manufacture of elements for electric batteries. The plates or elements are made of peroxide of lead brought into intimate contact by means of an aqueous solution of ammonia, which produces a slow chemical change in the peroxide, causing it to become a permanently coherent mass. These plates are then treated with a solution of oxide of lead in caustic alkali. Means for making contact between the elements and the conductors are provided, which consist of an elastic fitting piece pressing platinum foil in contact with the interior of the element, the said platinum foil being connected to the conductors.

ALUMINIUM.—Mr. A. B. Cunningham has patented a process for producing aluminium and aluminium alloys. A bath of molten lead alloyed with metallic sodium is provided. The aluminium-containing substance is immersed in this bath, and volatilisation takes place, the fumes as they rise being caught and reduced before they can escape. The metal thus obtained having a very low specific gravity and no affinity to lead, rises to the surface, whence it may be skimmed off, and afterwards separated from any adhering lead. The process is continuous, as after the removal of the aluminium the bath is replenished with the amount of lead skimmed off, and recharged with sodium.

ELECTRO-DYNAMIC GENERATORS.—Mr. R. Tathan has patented improvements in electro-dynamic generators and motors. The armature, or equivalent, of such machines is provided with a commutator which rotates in contact with brushes, and the object of the invention is to increase the durability and efficiency of the armature. To carry this out, a to-and-fro motion is given to the brushes, in the direction of the longitudinal axis of the armature. Carriers are provided, and connections whereby the desired motion is imparted to the brushes, and apparatus is provided capable of being thrown into and out of contact with the commutator, for the purpose of truing, polishing, and maintaining the commutator circular in cross section.

CHROMIUM.—Messrs. T. and E. Rouff have patented a process for the manufacture of chromium, based on the simultaneous employment of alkaline or alkaline earthy chromates, and silica. A neutral chromate is mixed with flint and charcoal, placed in a reducing apparatus and heated to a red heat. At this temperature a silicate and free chromic acid are formed, and the latter is reduced to metallic chromium by the carbon. This spongy chromium is washed to eliminate the silicate, and a chromium is obtained containing the impurities of the materials employed. If to the mixture of the neutral chromate, etc., oxides of copper be added, alloys of copper and chromium are obtained in a single operation.

POWER HAMMERS.—Mr. A. Davy has patented a power hammer which is self-acting and operated by steam. According to this invention the piston is fitted in a cylinder whose lower end is always open to steam pressure, and in which the steam is exhausted from the lower to the upper side of the piston, and thence to the atmosphere, the arrangement of the exhaust ports and the length of the piston being such that one of the ports is always closed by the piston. The length of the piston is about equal to the stroke, and the areas of the upper and lower faces of the piston are so proportioned that the steam, after having passed from the under to the upper end of the cylinder, will, owing to the larger area of the upper surface of the piston, overcome the pressure of the steam on its under side.

DIARY FOR NEXT WEEK.

Tuesday, Nov. 20.—Institution of Civil Engineers, 25, Great George Street, Westminster, S.W., at 8 p.m.—*Friction-Brake Dynamometers*, by Mr. W. Worby Beaumont, M.Inst.C.E.

Zoological Society of London, 3, Hanover Square, W., at 8.30 p.m.—*Contributions to the Skeletal Anatomy of the Mesosuchia, based on fossil remains from the clays near Peterborough, in the collection of A. Leids, Esq.*, by Mr. J. W. Hulke, F.R.S., F.Z.S.—*On the Small Mammals of Duval County, South Texas*, by Mr. Oldfield Thomas, F.Z.S.—*On the Mammals obtained by Mr. C. M. Woodford during his second expedition to the Solomon Islands*, by Mr. Oldfield Thomas, F.Z.S.—*Liste Supplementaire des Oiseaux recueillis en Corea par M. Jean Kalinowski*, by M. L. Taczanowski, C.M.Z.S.

Wednesday, Nov. 21.—Royal Meteorological Society, 25, Great George Street, Westminster, S.W., at 7 p.m.—*Results of an Investigation of the Phenomena of English Thunderstorms during the years* 1857-59, by Mr. G. J. Symons, F.R.S.—*Notes on the Meeting of the International Meteorological Committee at Zurich in September*, 1888, by Mr. Robert H. Scott, M.A., F.R.S. Models of Hail-stones—spheres about 2½ inches in diameter—forwarded by Mr. A. C. Stratten, will be exhibited.

Thursday, Nov. 22.—Society of Telegraph Engineers and Electricians, 25, Great George Street, Westminster, at 8 p.m.

Saturday, Nov. 24.—Physical Society, Normal School of Science, South Kensington, at 3 p.m.—*On the Measurement of the Luminosity of Coloured Surfaces*, by Captain Abney, R.E., F.R.S.—*On the Suppressed Dimensions of Physical Quantities*, by Professor Rücker, F.R.S.

SELECTED BOOKS.

The Metallurgy of Gold. A practical Treatise on the Metallurgical Treatment of Gold-bearing Ores, including the processes of Concentration and Chlorination, and the Assaying and Refining of Gold. By M. Eissler, formerly Assistant Assayer of the U.S. Mint, San Francisco. With ninety illustrations. London: Crosby Lockwood and Son. Price 7s. 6d.

The Principles of Agricultural Practice as an Instructional Subject. By J. Wrightson, M.R.A.C., F.C.S., etc., Professor of Agriculture in the Normal School of Science and Royal School of Mines, etc. With Geological Map. London: Chapman and Hall, Limited. Price 5s.

SALES.

EXCHANGES.

METEOROLOGICAL RETURNS

for the ten weeks ending on Monday, Nov. 5th, 1888. Specially prepared for SCIENTIFIC NEWS from official reports.

	Mean Temperature.	Rainfall.	Duration of Sunshine.
Scotland, East	49·0 degs., being 0·3 degs. below average.	4·3 ins., being 3·6 ins. below average.	218 hrs., being 22 hrs. below average
England, N.E.	49·5 " " 1·3 " " "	4·2 " " 2·2 " " "	218 " " 8 " above "
England, East	50·6 " " 2·6 " " "	4·6 " " 1·7 " " "	287 " " 33 " " "
Midlands ...	49·6 " " 2·8 " " "	4·3 " " 2·7 " " "	259 " " 25 " " "
England, South	52·1 " " 1·8 " " "	5·3 " " 1·4 " " "	303 " " 52 " " "
Scotland, West	49·7 " " 0·8 " " "	5·9 " " 5·4 " " "	218 " " 13 " below "
England, N.W.	50·5 " " 1·9 " " "	5·2 " " 3·8 " " "	239 " " 18 " above "
England, S.W.	50·8 " " 1·8 " " "	6·6 " " 3·9 " " "	275 " " 29 " " "
Ireland, North	51·3 " " 1·0 " " "	4·9 " " 3·4 " " "	198 " " 17 " below "
Ireland, South	51·6 " " 1·3 " " "	4·8 " " 4·0 " " "	257 " " average
The Kingdom...	50·5 " " 1·6 " " "	5·0 " " 3·2 " " "	247 " " 11 hrs. above average.

Scientific News

FOR GENERAL READERS.

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CONTENTS.

SCIENTIFIC TABLE TALK.

BY W. MATTIEU WILLIAMS, F.R.A.S., F.C.S.

THE readers of SCIENTIFIC NEWS have had before them, in Nos. 17, 18, 19, a description of the curious observations that have been rec ntly made on "the mysteries of Mars," and of some of the efforts to explain them.

Twenty years ago I wrote an essay on "The Meteorology of Mars" which constitutes the sixteenth chapter of "The Fuel of the Sun," and have quietly watched the observations that have been made at each subsequent opposition. These observations not only confirm my original views of the atmospheric conditions prevailing on this planet, but as regards the "canals" they present phenomena which I partially anticipated, and which follow as natural consequences of the conditions I then theoretically described.

The reader may ask, What has the meteorology of Mars to do with the fuel of the sun? A short explanation will answer this. In the first chapters of the book I discuss the limits of our atmosphere, and show reasons for concluding that it and our aqueous envelope are merely portions of the universal medium pervading all space, and that their quantity attached to each orb is proportionate to its gravitating energy. This was a heresy twenty years ago, but is now widely accepted.

Knowing the gravitating energy of the earth and the quantity of its atmosphere, we are supplied with units affording data for calculating the density of the atmosphere of other orbs, provided we know respectively these two elements and their dimensions. Solar phenomena follow of necessity in all cases where there are solar dimensions.

As an *experimentum crucis* I calculated thus the theoretical atmospheres of the moon and all our planets, and compared the results with observed phenomena. All came right excepting Mars, which had hitherto been described as a planet with a dense atmosphere, while my calculation gave it a total supply of atmospheric matter equal to about $\frac{1}{20}$ of our own, or, allowing for the smaller base upon which it is resting, it becomes an atmosphere having a pressure of $2\frac{3}{4}$ lbs. on each square inch of the planet's surface, against 15 lbs. on ours. Therefore, the mercurial barometer should there stand at a mean of $5\frac{1}{2}$ inches, and water should boil at 138 degs. Fah., be as volatile as bromine, and much more so than alcohol down here.

But what were the grounds upon which the accepted estimate of the planet's dense atmosphere was based? I found on examination that there were none beyond a fanciful assumed provision for maintaining a temperature suitable for supposed human inhabitants. No measure of refraction by occultation had been made, and when fairly interpreted, all the telescopic phenomena flatly contradicted it.

If such an atmosphere prevailed with the assumed protecting vapours, Mars should have dense clouds. Mars has no such dense clouds. But there is something that occasionally obscures the planet, especially towards its outer visible boundaries, during opposition, when we best see it.

With such an atmosphere as my calculation demands, with such volatile water, on a planet with the intensity of solar heat at its surface less than half of that on the earth (0·431 to unity), there could exist "nothing denser than a thin veil of stratus, or cirro-stratus, cloud, formed of ice crystals, the kind of cloud or mist which in our upper atmosphere makes halos round the moon. The mid-day region and a certain distance around it would but rarely be subject to this small degree of obscuration, as the sun's heat there should, under ordinary circumstances, hold in transparent solution all the vapours it had raised." Outside of this circle, north, south, east, and west, "a deposition of hoar frost must be continually taking place all round the disc of the planet, and this will commence at a certain angular distance from the meridian centre of the disc, and increase gradually towards the circumference. The rotation of the planet will, however, produce a considerable difference in the results of this deposition. All that falls on the east and west sides oı the planet will be thawed and evaporated by the next day's sunshine, so that the maximum accumulation in these directions can be but one night's deposition; but on the north and south there will be a continuous accumulation which will only be thawed up to a certain latitude by the annual summer presentation of either hemisphere to the sun." ("Fuel of the Sun," page 169.)

Now let the reader turn to page 433 of this magazine, and he will see by Schiaparelli's diagram that what I described theoretically twenty years ago was observed by him in May and June of this year. The letters *bbbbb* surrounding each picture indicate "white spaces," besides the well-known polar patches.

With apology for inevitable egotism, I will quote my own essay again. "At the poles and for some distance around them, the annual amount of deposition must exceed the annual amount of thawing and evaporation, and therefore a gigantic glacial mountain must there accumulate, with a continual growth and tendency to assume the conical form. As the deposition of ice crystals would commence before actual sunset, and would probably reach its maximum, or even be finished, before reaching the boundary line of day and night (in consequence of the thinness of the atmosphere and the resulting rapidity of radiation), the building up of this polar mountain would be very irregular. In mid-winter the lower slopes would receive the greatest accessions. With the advancing line of daylight the elevation of the zone of maximum deposition would increase until it reached the summit. This coincidence of maximum deposition with the summit would occur twice a year, before and after mid-summer. During the summer the only regions receiving any deposition at all would be the summit and its immediate vicinity; while at the same time the sides would be rapidly thawing by the powerful action of the continuous sunshine of the one long arctic summer day. *At this season, the slopes of the arctic mountain would be riven by gigantic ice-floods and water-floods, avalanches, glaciers, and torrents.*"

The "canals" are, I believe, these "water-floods" or "torrents." Their theoretical magnitude will be understood by considering the dimensions of the polar ice mountain, which, according to Professor Phillips, reaches in winter to latitude 50, that is, nearly half way from the pole to the equator of the planet; the polar snow circle as seen by the telescope has a diameter of 2,000 miles in winter, on a world having but half the diameter of ours. Its reduced summer diameter is about 500 miles; thus a ring of ice measuring 6,283 miles in outer circumference, and 750 miles broad, is thawed away in half a Martian year. Its thickness, according to my original estimate, is measurable in miles. The consequent floods must be enormous, vastly beyond anything within the reach of our terrestrial experience, although on a globe so much smaller, only one-fourth of our area.

Over what kind of ground would these great torrents flow? As I have shown in the above quoted essay, the seas of the tropical and temperate zones of Mars cannot be of liquid water; they must be oceans of ice, the mere surfaces of which are daily thawed and refrozen. Thus the apparent paradox of these rivers crossing the seas as well as the land, is explained.

Besides this, there should be, as I have argued, a great moraine heap surrounding the regions of polar snows; this ring moraine "consisting of the materials which the advancing polar glacier has scooped out and driven before it. This perpetual out-thrust of the great polar glacier—this continual erosion of the circumpolar regions of the planet, ever at work since the date of its primeval consolidation, must have produced a sensible alteration of the shape of the planet—must have flattened it in the immediate neighbourhood of its poles, and bulged it in the moraine regions beyond."

We thus obtain theoretically a great ring-shaped circumpolar lake, walled up by a surrounding ring-shaped ridge of moraine matter of mountainous dimensions.

Between the time of the writing and publishing of these speculations, Mr. Browning published his stereograms of Mars and some charts. On these are shown a ring of water completely surrounding the limits of the North Polar ice, to which Mr. Proctor gave the name of Schröter Sea, and beyond this a circular ridge which he calls "Laplace Land." Similar features are repeated around the South Pole, where the circular erosion valley is named "Phillips Sea," and the ring moraine is, on its polar boundary, so symmetrical that it nearly represents a parallel of latitude, but on its equatorial side has some remarkable promontories bearing the names of "Cassini Land" and "Lockyer Land."

If my theoretical views are sound, the waters of these circumpolar seas must in the Martian summer time rise to the upper limits of the great moraine barrier and overflow or break through it, then flow onward in a course determined by the general slope, which should be pretty regular, owing to the regularity of the piling-up action.

In reference to this it should be remembered that the Martian summer is nearly double the length of ours, the tilting of its axis a little greater, and the eccentricity of its orbit much greater, all increasing the variations of climate. Therefore the winters of the polar regions must be intensely cold and the summers hot, and their heat most effective, on account of the continuous sunshine. The amount of thawing would therefore be enormous, and floods pouring over or through the barrier proportionate.

If it should happen that two notches or outlets of the great moraine ridge occur near together, a great river would flow from each. With similar conditions of slope, their courses should be nearly parallel; hence the "germination" or twinning of the "canals." I must not be tempted into further details, having already overrun my space.

CAUSE OF THE ABSENCE OF TREES IN THE AMERICAN PRAIRIES.

FOR a considerable time the grass-fires which in former days recurred almost periodically have been regarded as the chief cause of the absence of trees in the wide prairie districts of North America, since they must infallibly destroy any young growth. Still, they cannot have been the original cause, for the prairies existed before human beings and fires could have occurred. Another hypothesis has sprung from recent investigations on loess and laterite; the "ground-water" in the prairie regions lies at such a depth as to be out of the reach of the roots of the young trees. Hence seedlings perish in the first prolonged drought, and trees can in consequence maintain themselves only on the margin of rivers. One striking phenomenon, however, could not be thus explained—the occurrence of isolated woods, not in hollows, but, on the contrary, on sandy eminences where they might have least been expected. The most extensive case of this kind is the forest belt known as the Cross Timbers.

Professor Thomas Meehan has recently given a very satisfactory explanation of this phenomenon in a paper read before the Philadelphia Academy of Sciences. He has observed in the neighbourhood of Roan Mountain, in North Carolina, small tracts of grass land lying isolated in the forest. These tracts have evidently maintained their boundaries very accurately for a long time, and are surrounded by very ancient trees. They have been formed by *Danthonia compressa*. The seeds of trees which fell upon the grass were unable to reach the soil, and thus withered away; but as soon as cattle were turned upon these meadows, and the grass was eaten down, young trees sprang up everywhere; and though most of them were browsed down by the cattle, some escaped, shot up, and finally overspread the entire meadow. Meehan applies this observation to the great prairies. He considers that the grasses took possession of these regions soon after their elevation above the sea level, and certainly before the seeds of trees could be brought thither and could be developed. The trees advancing laterally found themselves checked by the grass, which hindered their seeds from vegetating, and only permitted them to advance very slowly by suckers from the roots. Since the advent of man they have been further retarded by the prairie-fires. The sandy tracts formed an exception, as upon them the grass grew less luxuriantly, and the seeds of the trees were able to vegetate. Thus in the prairie region we meet the striking phenomenon that the sandy tracts are wooded, whilst richer soils remain covered with grass.

NEW HEATING APPLIANCES.

MESSRS. FLETCHER AND CO., of Warrington, have just added two more heating apparatus to the already large variety introduced by them. Fig. 1 represents an instantaneous water heater which is at once simple and efficient. It can be made only 14 ins. long by 6 ins. high, and can be fixed to a wall as illustrated; a heater

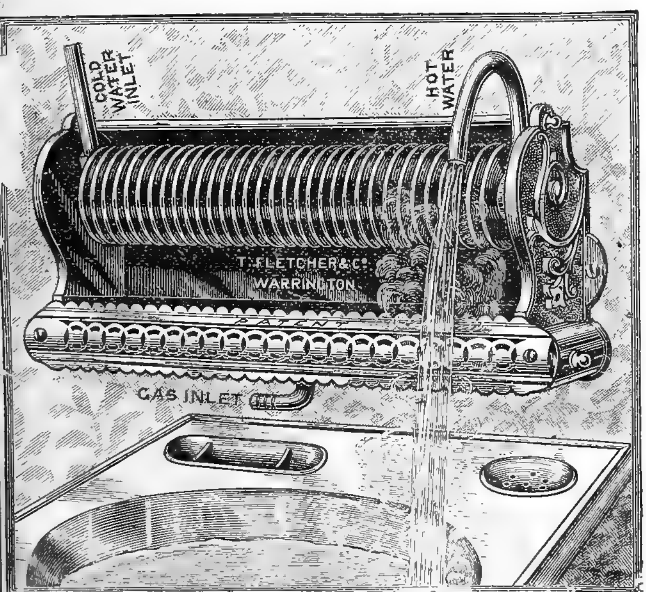


Fig. 1.

of this size will yield one quart of water per minute, heated from 60 degs. to 125 degs. F. It will be seen that a large number of circular flanges are attached to the cylindrical body of the heater, and as these flanges are made of copper, and as jets of gas are burnt under them, they offer a large heating surface and conduct heat rapidly to the water. The heater is strongly made, and is not easily injured even if the gas is lighted and the water forgotten. The inlet and outlet tubes at each end of the heater are interchangeable so that they can be fixed on whichever end is most convenient.

Another useful little apparatus is shown in Fig. 2. This consists of an atmospheric burner, above which there is a movable cylinder, and on this a stand for

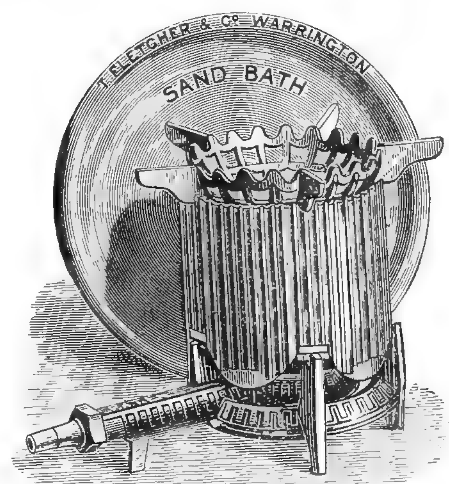


Fig. 2.

glass flasks, porcelain dishes, flat-bottomed vessels, or a sand bath. By lowering or raising the cylinder the vessel to be heated can be placed at different heights, and by this simple contrivance and by turning on the gas more or less the temperature can be closely regulated. These burners are made in four different sizes.

THE GREENLAND EXPEDITION.

THE *Times*, in a letter from a Danish correspondent, gives the following account of Dr. Frithiof Nansen's adventures in his attempt to cross Greenland on snow-shoes:—

In May Dr. Nansen and party left in the *Thyra* for Iceland, *viâ* Granton, and on June 4th they embarked in the Norwegian whaler, the *Jason*, Captain Jacobsen, who had promised to take them to the eastern Greenland coast in Denmark Sound. Circumstances did not prove as favourable as had been expected, and the *Jason* had to try several places without being able to come near enough to the shore. At last a convenient point was found outside the Srmilik Fjord at about 65 deg. 30 min. N. lat., and on July 17th, at 7 p.m., the doctor and his five men, with their well-packed baggage, were landed on the ice rim. From Isafjord, in Iceland, they had brought a little pony, whose assistance they had reckoned upon for drawing their heavy sledges over the first ice and for then supplying them with some fresh meat, but fodder got short on board and the pony had to be killed before leaving. The party had a light boat to help them over open spaces in the water, and their first advance, as seen from the vessel, appeared quite satisfactory. The last that was seen of them was some hours later, when, from a huge ice-block, they waved their adieu and disappeared in the fog. Since then until now nothing has been known of the party, fear and hope struggling for the upper hand. We now learn that not less than twelve days were spent on the ice before they reached *terra firma*, and it will most likely turn out that this part of the expedition was the most trying and the most dangerous. The landing was effected some 300 miles more to the south than originally intended, and this proves that strong southernly currents must have carried the ice floes along the shore and away from it. How they managed to climb the steep glaciers in order to get upon the real inland ice we are not as yet told, but the actual journey across, beginning on August 15th, took forty-six days. The distance being about 400 miles, this gives a daily average of less than ten miles, but it appears that when the party had reached an altitude of some 7,500 feet a northern snow-storm compelled them to deviate from their intended course, whereby the actual distance traversed has evidently been much increased. The highest altitude registered was over 10,000 ft., and here they found a temperature of from –40 deg. to –50 deg. C. At the end of September the descent, the last but not least dangerous portion of the trip, was made, not at the colony of Christianshaab, as first intended, but in a small bay not far from Godthaab. Dr. Nansen and Mr. Sverdrup here built a kind of boat or floating raft with their sleeping-bags and some drift timber, and leaving behind the four others, managed to reach Godthaab. Here they found that the last vessel for this season had left, but they heard that there might be some chance of there still being a steamer ready for starting at Ivigtut, the Cryolith shipping-place, and so they hired two kajak-men to bring letters to Ivigtut. The *Fox* had then gone, but some mishap to the engine had compelled the steamer to return for repairs, and it was only half an hour before its second starting that the kajak-men, paddling with all speed from the north, were observed. Dr. Nansen's letter to the captain of the steamer pleaded hard for himself and his followers to be waited for some days—he ventured even to say only for four days—and expressed in touching terms his and their longings for home after so many dangers and fatigues. It seems to all a great pity that the captain did not feel competent to meet this fervent wish, even if it should have taken a longer time, but peremptory orders from home, where this incident had not been foreseen, bound his hands, and the advanced season did, in fact, expose his steamer, already crowded with passengers, to the danger of being frozen in if he had tarried longer, and he felt sure that the whole party could not have reached him in less than a month. So Dr. Nansen and his followers will be compelled to stay over the winter at Godthaab, but as this colony is, relatively speaking, quite a big place, they will have every comfort that civilisation and human company can afford until next spring brings them home to receive the reward of praise and admiration to which their courage, pluck, and endurance so fully entitle them. It is hoped that the letter from Dr. Nansen which the *Fox* is announced to bring for Mr. Gamel will contain some continuous and succinct report of the various stages of the expedition. If that proves so I shall forward you a translation of it.

In a subsequent issue of the *Times* the following appeared :

The short letter from Dr. Nansen to Mr. Augustin Gamel, in Copenhagen, the defrayer of the expenses of the expedition, is as follows :—

Godthaab, Oct. 4th.

I have at last the great joy to report to you that Greenland has been successfully crossed from east to west. I regret that the very short time left to me before despatching my messengers will not permit any detailed account. I can just jot down a few words to be forwarded by the kajak-men I am sending southwards in the hope of stopping the *Fox* at Ivigtut, and getting her to wait for us and take us home this autumn. But in case the kajak messenger should catch the steamer without inducing her to wait for us, I write these few lines just to inform you that we are all alive and well.

As you will know, we left the *Jason*, the Norwegian sealer, on July 17th, and expected to reach the shore the next day. But in this we were sadly disappointed. Screwing ice, maelstroms, impassable ice, where it was alike impossible to row or to drag the two boats, stopped us. One of the boats was stove in, but we got it repaired again. We drifted seawards at a speed of 30 sea miles in the 24 hours. Drifted in the ice for 12 days. Strove hard to get to the shore, were three times on the point of succeeding, but were as often carried out to sea again by a current stronger than our power of rowing. Were once, for a whole day and night, very near perishing in tremendous breakers of the sea against the ice-rim. After 12 days drifting about, we managed at last to get ashore near Andretok, north of Cape Farewell, at 61 degrees and some minutes of northern latitude. We rowed again northwards, reaching Uminik, from which point the crossing of the inland ice began on August 15th.*

We directed our course for Christianshaab on the western coast. Encountered severe snowstorms and had heavy ground. Estimating that it would be too late to reach Christianshaab in time for this autumn's vessel, we altered our course and steered for Godthaab, the ice-fields in that direction having, besides, been hitherto trodden by no one. After altering course reached height of 10,000 ft., with temperature of 40 degs. to 50 degs. C. below zero. For several weeks we remained at an altitude of over 9,000 ft. Tremendous storms, loose, new-fallen snow, enormously difficult passage. Towards end of September we reached at last the western side above Godthaab. Had a perilous descent on ugly and very uneven ice, but got safely down to Ameralik Fjord. Managed to build a kind of boat from floor of tent, bags, bamboo reeds, and willow branches. In that frail craft Sverdrup and I rowed away, and arrived here on October 3rd. The four men are left at Ameralsk, living there on short rations fare, but will be sent for as soon as possible.

There you have in short outline our Saga. We are all perfectly well, and everything has been in the best order. I hope that we may catch this steamer, and that instead of this letter you may see our sunburnt faces.—With many greetings, yours ever devotedly, FRITHIOF NANSEN.

P.S.—Just now the kajak-men must leave, profiting by the favourable weather. They have 300 miles to make before getting to Ivigtut.

At the same time is published a letter from Mr. Sverdrup to his father, and as this gives certain supplementary details, I give a translation also of that :—

Godthaab, Oct. 4th, 1888.

We arrived safely here yesterday after forty-six days' wandering from east to west. It did not prove so easy to get on shore from the *Jason* as we had expected. We got into formidable ice-screwings, and the current took us southwards and out from the shore, so that we had twelve days' very hard work before getting to land, and that 300 miles more to the south than we had intended. We began at once to work back along the coast, and this took us another twelve days, so that we did not begin our crossing of the ice before August 15th. The ascent was very fortunate, as we chanced to find comparatively easy ice to climb up. We shaped our course for Christianshaab, but after getting up to 7,500 ft. we were attacked by a northern snowstorm. We resolved, therefore, to set our course for Godthaab, the distance being shorter, and there being a better chance of favourable winds. I may

* It appears that after getting into the shore the party found a line of open water between the land and the ice rim. It must have taken them even more than twelve days to regain the ground they had lost by drifting to the south, since the crossing did not begin before August 15th.

truly say that we had a hard time of it. The snow and ice were very heavy, and the weather was trying. For nearly three weeks we were up at nearly 10,000 ft., and had a temperature of —40 degs. to —50 degs. C. Only for four days were we snowbound. After all, we have to be thankful it was not worse. After getting down from the inland ice on the western coast, we had before us some ninety miles of barren country, of which the half lay along a fjord. We tried to cross here, but found it too hard work; so we managed to construct a kind of boat from the bottom of the tent and some bags, and in that, after four days' rowing, Dr. Nansen and I reached here, where we had the most cordial reception from all the inhabitants of the colony. Two boats have now been sent to the bottom of the fjord to fetch our comrades. The regular vessel has long since left, but some 250 or 300 miles further south there is supposed to be, at Ivigtut, a steamer loading for Copenhagen, and we are now sending a kajak-message in order to stop that steamer if possible. We have but little hope of that, however, and are preparing to pass the winter here. That may be very comfortable after all, but, of course, we would prefer getting home. I must hurry up, as we are now going to dine with the parson, and, in fact, we have not had time for anything, as since arriving here we have gone from one social party to another. You may see from that how well we are off. I was the only one of our whole party who got over all the tremendous fatigues without the smallest ailment. I am, and have been all the time, as fresh and sound as a fish.—With the kindest regards, etc.

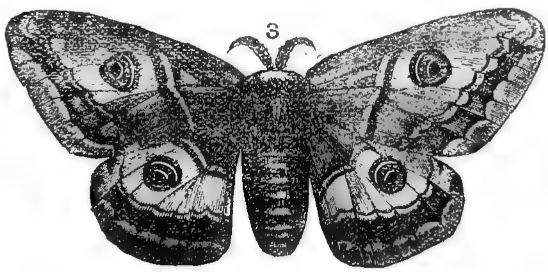
THE NEGLECTED SENSE.

If in ordinary modern life any one of our senses may be pronounced useless, it is that of smell. Yet it has capabilities which are quite overlooked, and which, if systematically cultivated, might enable it to play a part in the study of the natural sciences second to that of sight alone. Hearing, however important it is as a means of communication with our fellow-men, is almost out of court in the exploration of natural phenomena.

Of course the acuteness of smell in man is much less highly developed than it is in certain of the lower animals. Everyone is familiar with cases proving the wonderful olfactory power of the dog, especially of the bloodhound. But the faculty of scent in certain insects is inconceivably more acute and delicate. This is especially the case with moths. If a virgin female of certain species, *e.g.*, *Saturnia carpini* or *Sphinx convolvuli*, is shut up in a box, males of the same species will come flying, even though the nearest locality where they could have been concealed is at the distance of nearly a mile, and though woods, eminences, and houses may intervene. The emanations from the female moth, of whatever nature they may be, are evidently diffused through space and diluted with an excessive quantity of air, which may be scentless or may be saturated with other odours. Yet this infinitesimal trace is sufficient to guide the male towards her with unfailing accuracy. This is as if a human being were able to detect the presence of an individual of his own species at the distance, according to the lowest computation, of from four to five miles. Did hounds possess such a sense they would not search and snuff about for the track of the fox, but would go at once in a straight line to the spot where he might be lurking.

Such feats we cannot hope to rival. We do not possess the highly-developed olfactory nerve of the dog, or the plume-like antennae of *Saturnia carpini*. But even among mankind the sense of smell reaches a degree of delicacy which is to other persons scarcely credible. The aborigines of Peru, Chili, and other parts of South America can, in the darkest night and in the thickest woods, distinguish respectively a white man, a negro, and one of their own kindred by the smell. They have in their own language words to express the differences —words which, of course, cannot be rendered into any European tongue. But our defective power of smell, as compared with that of such semi-savages, is due not to any natural deficiency on our part, but to our manner of living. The writer feels justified in making this assertion from an instance which came under his own observation. A lady who had suffered long and severely from neuralgia was at last advised to renounce tea and coffee, all hot liquids, all spices, condiments, and everything else of an irritating or stimulating nature. She carried out this advice, and her power of smell became quite a wonder to all her acquaintances. Her judgment on the purity of a water supply became more than analytical in its accuracy and delicacy.

Here, then, lies the secret. She lived as far as foods and drinks are concerned, like the native Peruvians, and if she did not quite equal them in the nicety of her sense of smell, it was because in her earlier life she had been in the habit of using mustard, pepper, hot tea, and the like. It is, therefore, very probable that a similar style of living would in all persons very much improve this



Saturnia Carpini.

neglected sense. Even at present, according to a paragraph from *Liebig's Annallen* quoted in our number for July, 1887, our smell is more delicate than our eye-sight. No little admiration has, for instance, been excited by the delicacy of the spectroscope. We all know how, by means of this instrument, extremely minute portions of various chemicals—far too small to respond to any other test—may be made clearly evident to our sight. Of these spectroscopic indications the most delicate of all is the yellow band which appears when a trace of the metal sodium is burnt in a gas-flame or in an electric spark (see articles on the spectrum in our numbers for June, July, and August, 1887). But without the aid of any instrument, and without any previous training, the human nose is capable of detecting quantities of certain substances thirty times smaller. It is possible to recognise by smell $\frac{1}{4000000000}$ of a milligramme of mercaptan, and as a milligramme is only the 0·0154th of an English troy grain we have here a degree of delicacy of which it is hard to form any definite idea!

There is another circumstance which gives additional value to scent-indications. Although we have no names for different smells and can merely describe them by comparisons, they fix themselves in the mind far more permanently than the impressions of the other senses. If we have once met with any particular odour, we recognise it years after, even though we may never have come across it in the interim.

Of this we have a remarkable instance in our personal experience. When the writer was at the age of ten, a lady who had lived many years in South Africa, returned to England, bringing with her a large quantity of buchu-leaves. All her clothes were saturated with the scent of this drug, and as she paid a visit to our family we were struck with the smell, though we did not even know the name of the plant. Some thirty years afterwards happening to call upon a medical friend, we recognised this smell in his house, and found that he was experimenting on the best method of obtaining the virtues of the plant in a concentrated form.

It will be admitted that to the biologist the sense of smell may be of great service in recognising animal and vegetable species. The chemist, in like manner, uses it in distinguishing volatile bodies, and may often by its aid obtain a valuable hint as to the reactions which are going on. What is wanted is, firstly, a nomenclature for smells, just as we have for colours and for sounds, so that we may put on record and make known the impressions which we receive.

Secondly, we want means for training this sense. Few persons, perhaps, would be willing to renounce spices, condiments, spirits, hot liquids, tobacco, etc., but it may be useful to know that a draught of cold water, held in the mouth but not swallowed, gives a temporarily increased delicacy to the smell.

It may also be asked how far we can obtain in our researches the assistance of insects? Bees have already served to detect the difference between true cane-sugar and its hated rival beet-sugar—a distinction which our scientific instruments have hitherto been unable to show.

ARTIFICIAL CAVERNS.

IN various parts of the earth there are found cavities evidently of artificial origin, and as evidently not connected with mining or with any other industrial operations. Such excavations, in the form of underground passages, are particularly abundant in Bavaria and Austria, and have for some time attracted the attention of archæologists. The following account of these so-called "earth-stalls" is chiefly derived from the *Beitragen zur Anthropologie und Urgeschichte Bayerns*, the *Mittheilungen der Anthropol Gesellschaft in Wien*, and the *Naturforscher*.

The number of these evidently very ancient cavities is exceedingly great, and is being often increased by fresh discoveries. Many local traditions point with certainty to the existence in various places of underground passages which have not yet been brought to light.

These "earth-stalls," or goblin holes, have been particularly studied during the last nine years by the Rev. Lambert Karner. He has visited and explored nearly 200 such caverns in Lower Austria and Moravia, accompanied in many instances by his friend the artist Spoettl, who sketched the most remarkable features on the spot.

The "earth-stalls" form complete systems of passages and chambers. Their main feature is the labyrinthine ramification of the passages, which can be traversed only by one person at a time, and that generally in a bent or even creeping attitude. There are perpendicular passages or shafts, with holes into which the feet may be introduced in ascending or descending, some of them being seven yards in height. There are also at regular intervals small niches about the size of a fist, in which burning lamps have been placed, as appears from the traces left. The chambers have often an elegant form, and are fitted with seats or benches and large, handsome niches, with pointed or rounded arches. The size of these chambers, hundreds of which have been measured by Karner, is almost always alike—nearly 2 yards in height, and 1½ to 2 yards in length and breadth. Another curious fact is the uniform position of these chambers, and, indeed, of the whole structure, with reference to the points of the compass, as the angles of the chambers are turned towards the four cardinal points. Some of them have large niches, symmetrically arranged, with bell-shaped or dome-shaped tops.

At the summit there is often an air-hole, and a niche for holding a light is generally opposite the end of every passage. In many cases the access to the final chamber is very difficult, and this is excavated with especial elegance, and seems to have been a kind of sanctuary.

As an example we may take the caverns at Oberndorf. The passage leading to the last chamber from the last but one is only 20 ins. in width and 22 in height. It leads first due south, and then forms an angle and turns to the north-east. The chamber which is ultimately reached is distinguished by its size and shape from all others. It is 4 yards long, rather more than 1½ in width and height, with an arched top. In each of the sides there are two elegantly formed niches.

It must further be added that the plan often takes the form of a cross, and that the excavations are connected with wells locally regarded as holy. Both the passages and chambers have been provided with doors.

What can have been the purpose of these excavations? The oldest documents in which they are mentioned date from the beginning of the 13th century, but they are indisputably much more ancient. After considering the great extent of territory over which they occur—Bavaria, Upper and Lower Austria, along the Bohemian frontier, in Movaria, in Hungary, and Styria—and everywhere with the same characteristic peculiarities, and remembering that this region coincides with the great kingdom of the Quadi, Karner comes to the conclusion that the earth-stalls must date back to the time of the Quadi.

His conjecture is supported by the fact that artificial caverns have been found within the lines of the great Quadian fortress at Stillfried. Karner does not believe that these caves served exclusively as dwellings, since no fireplaces have been found in them. It is probable that the excavations were visited only at times, and that for a fixed purpose, probably for worship. Whether rites were here performed in honour of the dead is for the present doubtful, for in the hundreds of chambers which Karner has explored nothing decisive has been found, although he was told of skeletons lying there. In Moravia traditions are current of old men who dwelt in these excavations, and who on being touched crumbled away into ashes. According to a statement quoted by Harkmann, two urns were found in 1886 in an artificial cave in Upper Austria, the first discovery of the kind made in any of these excavations. But no details concerning these alleged urns have been made public.

If the conjecture be well founded that these caves are the work of the Quadi, they must date back to the first centuries of our era, for the very name of the Quadi, a race allied to the Marcomanni, who occupied the regions mentioned from the first to the fourth century, disappears from history entirely in the fifth century.

General Notes.

An Application of the Phonograph to Medical Studies.—According to *Cosmos*, it is proposed to supplement pathological treatises by a collection of typical phonographs representing the normal sounds of the heart and lungs.

Chemical Interaction of Solids.—Mr. W. Hallock (*Science*) has read a paper controverting the views of the Belgian chemist Spring. Hallock maintains that the chemical action detected by Spring is due to the vapour given off by one of the bodies.

Sanitary Neglect in Florida.—Sanitary investigations in Florida undertaken in reference to the epidemic of yellow fever show in some of the towns a most deplorable condition. In Maclenny, a small town of perhaps 600 inhabitants, the only water supply is obtained from wells of 15 to 20 feet deep, and inevitably polluted.

Royal Society.—We learn that the Copley medal has this year been awarded to Professor Huxley, in recognition of his investigations into the morphology and histology of vertebrate and invertebrate animals, and for his services to biological science in general during many past years. The Rumford medal is to be given to Professor Tacchini, renowned for his researches in solar physics, and the Davy medal to Mr. Crookes for his researches on the electric discharge in high vacua. The Queen has approved the award of the Royal medals to Baron Ferdinand von Mueller, the Australian botanist, and to Professor Osborne Reynolds, of Owens College, for his researches in mathematical and experimental physics. The medals will, as usual, be presented at the anniversary meeting of the Society on St. Andrew's Day.

Comparative Statistics of the Sexes.—Every census taken in Germany shows a decrease in the number of men and an increase of women. The last census shows a million women more than men, or 104·3 women to 100 men. There are still more boys than girls, which proves that a higher death-rate is the cause of the numerical inferiority of males, joined also to emigration. In Berlin women predominate to such an extent that there are more than 108 women to 100 men. Between the ages of 60 and 70 there are 150 women to 100 men, and between 70 and 80 no fewer than 196 women to 100 men. This shows that men expend more vital energy than women, and therefore succumb more readily to any destructive influence which they may encounter.

Adulteration of Wines.—The sophistication of wines and liqueurs in France is exciting not merely popular but official alarm, and at a recent Cabinet Council special legislative action was resolved on. Dr. Laborde, in a memoir laid before the Academy of Medicine, states that he has found in one litre of "liqueur de noyau" from five to six grammes of nitro-benzol, a highly poisonous product of coal-tar. The same liqueur is sometimes got up instead, with the aldehyde of benzo-nitril. The same authority shows that absinthe occasions tetanic convulsions. It is remarkable that none of our moral reformers call attention to the necessity of absolutely prohibiting the importation of this deadly liquid into Britain, and its manufacture and sale here.

The Edinburgh Exhibition.—Last Friday a meeting of the Edinburgh International Exhibition Association was held in Dowell's Rooms, Sir Thomas Clark presiding. The report of the joint committee, appointed by the association and the executive, as to the disposal of the exhibition surplus, recommended that the sum of £2,000 be paid to Sir James Gowans for services rendered to the exhibition, and that the surplus be thereafter divided as follows:—£1,500 to the Edinburgh Public Library, £1,000 to the Scottish Meteorological Society in aid of the Ben Nevis Observatory, £850 to the Edinburgh Exhibition Trust for the purpose of carrying on or assisting future exhibitions in Edinburgh or elsewhere, including artisan and amateur exhibitions, £100 to the Edinburgh Choral Union, £100 to the Royal Scottish Geographical Society, and £50 to the exhibition of decorative handiwork at present being held in Edinburgh.

Royal Geographical Society.—At the opening meeting of this session of the Royal Geographical Society, Mr. H. H. Johnston, the well-known traveller, and Her Britannic Majesty's Consul in West Africa, read a paper on the Niger Delta and the Oil Rivers. The theatre of the University of London, in which the meeting was held, was quite filled, the audience including several distinguished persons. Mr. Johnston's account of the Niger and its neighbours, their scenery, their luxuriant and varied vegetation, the native villages and towns on their banks, with their inhabitants, the results of European contact with the natives, and his own remarkable adventures, was of an unusually attractive character. Moreover, Mr. Johnston exhibited on the screen throughout his lecture a continued succession of pictures from the lantern, some of them from photographs, but most of them from his own beautiful sketches; while a large number of his original sketches were inspected by the interested audience after the lecture. The large map constructed under Mr. Johnston's care, which was exhibited, records the results of his own observations, and is a valuable addition to the cartography of West Africa.

A Spring over 3,000 feet Deep.—In carrying out the works for utilising the waters of the Seltzer Spring, Saratoga, for the purpose of liberating and storing in liquid form the carbonic acid gas with which the spring abounds, Mr. Oscar Brunler, who is superintending the arrangements, has made a remarkable discovery. The Seltzer Spring was discovered about three years ago by Dr. Haskins, who put down the drill to the depth of 500ft. At this depth an abundant supply of water was found flowing from a crevice in the rock bottom. Recently, in order to ascertain the depth of the spring, Mr. Brunler sounded it with a line and plummet; but, instead of resting at 500ft., the weight sank the whole length of the line, 900ft. Other soundings have since been made, the weight used being a piece of 1in. gas-pipe, filled with lead, and weighing 34lbs., until a depth of 3,300ft. has been reached, and yet without touching bottom or any obstacle. It will be impossible to take further soundings until instruments expressly designed for the purpose have been made. Mr. Brunler admits that the line may have been carried away by some powerful current, but he holds to his belief in the existence of a subterranean sea of greater or less extent, and of there being some connection between it and the Atlantic Ocean. In other words, Saratoga is over a vast water-filled cavern, the roof of which is about 500ft. thick. He also thinks it probable that at a given depth and temperature carbonic acid gas may be found in a liquid state. Should the existence of a subterranean sea be established, it would dispose of many theories and scientific speculations as to the source and course of the mineral springs at Saratoga.

The Equatorial Boundary of the Occurrence of Snow.—H. Fischer (*Berlin Gesellschaft für Erdkunde*) distinguishes between the mean altitude at which snow occurs every winter and the extreme boundary which it reaches in exceptional seasons. The immediate coasts of the Mediterranean, save to the north of the Adriatic and the Ægean, experience a fall of snow only exceptionally. From the Cilician Taurus the mean limit of snow extends over Mosul to Bagdat and Schiras, rises then to Teheran, and runs over Herat, Candahar, and Kelat in Beloochistan, on the mountains west of the Indus, to 28 N.L. On the southern slope of the Himalayas the boundary runs at about 5,500 feet above the sea level. In the interior of China the limit is not certainly determined. It cuts the Chinese coast to the north of Shanghai, touches the southern parts of Kiuschin and Schikoku (Japan), and meets the west coast of America in 47½° N.L. Passing through the Rocky Mountains and the Sierra Nevada, it turns downwards, almost to the tropic of Cancer. In Texas it bends to the north again, crossing the Mississippi in 31½° N.L., leaves America a little to the south of Cape Hatteras, and meets the French coast to the south of Bordeaux. In the southern hemisphere it follows in general the parallel of 40° S.L. Neither the coast regions of Tasmania nor the western and northern parts of the southern island of New Zealand suffer from snow every year. Along the Andes the line rises to 8° S.L. Snow falls occasionally in Mesopotamia, Lahore, Canton, in Mexico, but never at the southern point of California. In the southern hemisphere snow occasionally falls along the Blue Mountains of Australia to 27° S.L. In New Zealand only the extreme northern point enjoys an immunity from snow. Snow has been known to fall in Rio de Janeiro, and even in 20° S.L., a little farther inland.

The Annual Ring in Trees.—In the course of his last report, the chief of the forestry section of the Agricultural Department of the United States, referring to the annual rings in trees, asserts that these exist as such in all timber grown in the temperate zone. Their structure is so different in different groups of timber that from their appearance alone the quality of the timber may be judged to some extent. For this purpose the absolute width of the rings, the regularity in width from year to year, and the proportion of spring wood to autumn wood must be taken into account. Spring wood is characterised by less substantial elements, the vessels of thin-walled cells being in greater abundance, while autumn wood is formed of cells with thicker walls which appear darker in colour. In conifers and deciduous trees the annual rings are very distinct, while in trees like the birch, linden, and maple the distinction is not so marked, because the vessels are more evenly distributed. Sometimes the gradual change in appearance of the annual ring from spring to autumn wood, which is due to the difference in its component elements, is interrupted in such a manner that a more or less pronounced layer of autumn wood can apparently be recognised, which again gradually changes to spring or summer wood, and then finishes with the regular autumn wood. This irregularity may occur even more than once in the same ring, and this has led to the notion that the annual rings are not a true indication of age; but the double or counterfeit rings can be distinguished by a practised eye with the aid of a magnifying glass. These irregularities are due to some interruptions of the functions of the tree caused by defoliation, extreme climatic condition, or sudden changes of temperature. The breadth of the ring depends on the length of the period of vegetation; also when the soil is deep and rich, and light has much influence on the tree, the rings will be broader. The amount of light and the consequent development of foliage is perhaps the most powerful factor in wood formations, and it is upon the proper use of this that the forester depends for his means of regulating the development and quantity of his crop.

The Public Health.—According to the Registrar-General's return for the week ending Saturday, November 10th, the deaths registered in 28 great towns of England and Wales corresponded to an annual rate of 19·0 per 1,000 of their aggregate population, which is estimated at 9,398,273 persons in the middle of this year. The six healthiest towns were Bradford, Brighton, Hull, Leicester, Halifax, and Wolverhampton. The highest annual death-rates, measured by last week's mortality, were—for measles, 1·8 in Blackburn, 2·2 in Portsmouth, 3·0 in Leeds, and 3·8 in Cardiff; from scarlet fever, 1·0 in Manchester, 1·2 in Salford, and 2·2 in Blackburn; from whooping-cough, 1·0 in Birkenhead; from "fever," 1·1 in Oldham, 1·3 in Newcastle-upon-Tyne, and 1·6 in Salford; and from diarrhœa, 1·4 in Bolton and in Cardiff, and 1·6 in Derby. The 45 deaths from diphtheria in the 28 towns included 34 in London, 2 in Liverpool, and 6 in Salford. Small-pox caused 1 death in Preston, and 1 in Hull, but not one in London or in any of the 25 other great towns. In London 2,770 births and 1,520 deaths were registered. Allowing for increase of population, the births were 70 and the deaths 167 below the average numbers in the corresponding weeks of the last ten years. The annual death-rate per 1,000 from all causes, which had been 21·2 and 19·7 in the two preceding weeks, further declined last week to 18·5. During the first six weeks of the current quarter the death-rate averaged 19·1, and was 0·4 below the mean rate in the corresponding periods of the ten years 1878-87. The 1,520 deaths included 109 from measles, 18 from scarlet fever, 34 from diphtheria, 15 from whooping-cough, 14 from enteric fever, 18 from diarrhœa and dysentery, and not one from typhus, ill-defined forms of fever or cholera; thus 208 deaths were referred to these diseases, being 11 below the corrected average weekly number. Different forms of violence caused 50 deaths; 37 were the result of negligence or accident, among which were 17 from fractures and contusions, 6 from burns and scalds, and 10 of infants under one year of age from suffocation. In Greater London 3,571 births and 1,896 deaths were registered, corresponding to annual rates of 33·7 and 17·9 per 1,000 of the estimated population. In the outer ring 9 deaths from measles, 7 from "fever," 6 from scarlet fever, 6 from diphtheria, and 6 from whooping-cough were registered. Three fatal cases of fever occurred in Croydon, and 3 in Tottenham sub-district, and 3 of measles in Tottenham sub-district.

ON VERNATION AND THE METHODS OF DEVELOPMENT OF FOLIAGE, AS PROTECTIVE AGAINST RADIATION.

A Paper read by the Rev. George Henslow, M.A., F.L.S., F.G.S., before the Linnæan Society.

(*Concluded from p.* 506.)

THE tile-like arrangement of the uppermost stipules and subsequently of the leaves themselves, thus protecting the edges of the vertically placed leaves beneath them, reminds one of a very similar method of protection in *Trifolium repens* when asleep. In this plant the two basal leaflets rotate so as to bring their upper surfaces in contact and their blaces vertical, while the terminal leaflet revolves through half a circle and comes down upon the upper edges like an arched roof above them* (figs. 5 and 6).

Fig. 5.

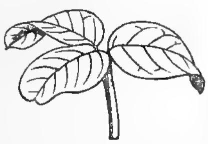
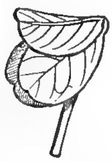


Fig. 6.



Trifolium repens.

Fig. 5.—Leaf during Day-time. Fig. 6.—Asleep during Night-time (after Darwin).

In the case of the Hazel the process is much the same, but with *Ampelopsis Veitchii* the blade spreads out at once, however young, and is not conduplicate; but as it hangs vertically from its very birth to its fall, it does not require any further protection beyond what the leaves above it happen to supply by overhanging it. The branches of this species cling so tightly to the wall that very possibly a good deal of heat is radiated

Fig. 7.

Fig. 8.

Fig. 9.

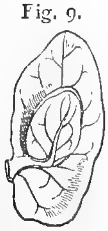


Fig. 7. Rose. Younger leaf erect; older with petiole curved and half-developed leaflets.

Fig. 8. Pea. Leaf emerging from between the stipules; the leaflets conduplicate.

Fig. 9. One stipule removed to show the erect bud within and protected by the stipules.

from the wall itself on to the back, *i.e.*, the underside of the leaf. The Beech differs from the Lime in having its young leaves dependent only, and not protected. They are feebly conduplicate, but with a plicate surface, and the stipules do not form any protection; and, contrary to what takes place in the Lime, the older, basal leaves, instead of covering the younger ones, hang below them the slender shoot curving at the apex so that the terminal and younger leaves have a tendency to be vertical, but not to so pronounced an extent as in the Lime. It may be noticed that the Beech does not open its buds till a later period than the Lime, and at a time when spring frosts are nearly over. The Spanish Chestnut agrees closely with the Beech, the leaves being at first subconduplicate, and similarly plicate, while each leaf on expansion is spread out below the terminal shoot. Both trees belong to the same section of the Cupuliferæ.

II. Compound Leaves (1) Opposite: (i) *erect.*—The Ash and the Elder are illustrations. As with simple leaves, the leaflets of compound leaves are almost invariably conduplicate; the Elder, however, as stated above, having the margins of the leaflets involute as well. They all stand erect at first and only gradually assume

Fig. 10.

Fig 11.

Fig. 12.

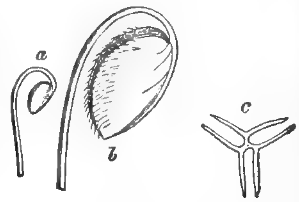


Fig. 10. Laburnum. Fig. 11. Clover.

Fig. 12. Wood--sorrel: *a*, nat. size; *b*, magnified; *c*, vertical aspect, in diagram as seen asleep.

the horizontal position on their complete development. The leaflets of the Ash are at first similarly clustered together, but simply conduplicate. With Weeping Ashes, in order to place the young leaves erect, the petiole is obliged to make a very strong curve upwards, not necessitated in the ordinary form of the tree.

(ii) *pendulous.* I have not met with an instance of

Fig. 13.

Horse Chestnut.

Fig. 14.

Lupinus pilosus. Leaf, seen laterally, asleep at night-time. (After Darwin.)

Fig. 15.

Walnut.

opposite compound leaves being pendulous in the young state.

(2) Alternate; (i.) *erect.*—Of compound leaves there are the two types, digitate and pinnate. Of the former, Lupin will illustrate this position. A specimen with white flowers had the leaflets all conduplicate at first and erect, forming a small but dense mass. Of the pinnate type with erect leaflets many instances might be mentioned, as, *e.g.*, Goutweed, Chervil, Sumac, Raspberry, and Rose. As a rule, besides being conduplicate and, in some cases, plicate in addition, the leaflets are all pressed together laterally, thereby affording a certain amount of mutual protection. This is well seen in the Rose

In the case of the Rose the developing bud is protected by the adnate stipules (fig. 7), and the young leaf, when

* Darwin, "Movem. of Plants," p. 349, fig. 141.

it merges, is at first erect (as in the Pea, figs. 8 and 9). The leaflets are conduplicate, and all five are pressed together laterally; for at this stage the petiole has not elongated sufficiently to allow of the pairs of leaflets being separated. As the petiole grows the whole collection of leaflets becomes more pendulous until they expand, and the leaf ultimately assumes the horizontal position. In the Garden Bean the leaves are conduplicate; but the margins are involute as well, so that the leaflets resemble so many quills.

(ii.) *pendulous.* Of the two types the following may be selected:—The French Bean, Wood-sorrel (*Oxalis*), Clover, and Laburnum as being ternate, and the Horse Chestnut and Virginian Creeper as being digitate; while the Walnut will exemplify the pinnate type.

The French Bean (*Phaseolus vulgaris*) bears at first a pair of unifoliate leaves; but those which succeed them are ternate. While very minute in size (one half to three quarters of an inch in length) the leaf is horizontal, but the leaflets are conduplicate with their edges uppermost. When a little larger (say, one and a quarter inches) the petiole bends down angularly, and the leaflets are in vertical planes, holding identically the same positions as when adult and asleep. As they increase in size, the leaflets rise up and take a horizontal position. They now become subject to hypnotism, falling at night and rising again by day.

The Wood-sorrel (fig. 12), Clover (fig. 11), and Laburnum (fig. 10) all agree in having their three leaflets conduplicate, pressed close together laterally and suspended vertically. The petiole is suberect in the Laburnum and Clover, but strongly curved at the apex in the Wood-sorrel, so that the minute leaf is under the concave end (fig. 12, *a* and *b*). When the leaf of the Oxalis is asleep, the leaflets fall vertically and bring their undersides in contact (fig. 12, *c*), but never resume the conduplicate condition again. The sleeping condition of Clover has been described above; but here, as in all other instances, conduplication once lost is never resumed.*

This seems to indicate that the danger from exposure in the very young state being much greater than in the adult, the protection is correspondingly more perfect.

In the Horse Chestnut (fig. 13) the digitate leaf has at first all the leaflets dependent and more or less covering one another. This is exactly similar to the condition of the leaflets of *Lupinus pilosus* when asleep, as described by Mr. Darwin† (fig. 14). It may be added that the leaflets of Lupin are at first clustered together and conduplicate. The Virginian Creeper has its five leaflets at first conduplicate and suberect; they gradually curve over and spread themselves vertically like a star, not unlike the method adopted by *Lupinus pubescens*, as described by Mr. Darwin.

The petiole of the Walnut-leaf (fig. 15), on emerging from the bud (the scales of which, like those of the Ash, are petiolar), curves strongly downwards, so that the leaflets, which are conduplicate, stand in a vertical plane. As the basal ones expand they still remain with their surfaces vertical, and it is not until they are approaching maturity that the petiole rises up and the leaflets spread themselves out horizontally.

Besides vernation, conduplication, and the subsequent vertical position of leaves and leaflets, as calculated to protect them from the evil effects of radiation, hairs and tomentum, etc., must not be forgotten as being bad conductors of heat, and therefore very important aids to protect the organs clothed with them. Foliar organs and axes, when young, are often very hairy, silky, or woolly, as the case may be, which in older states become glabrous, either by the hairs becoming more sparsely scattered by epidermal growth, or by vanishing altogether. Similarly the stellate pubescence or woolly clothing, which is not an unfrequent character of the young condition, often disappears as soon as the surfaces thus protected are sufficiently advanced to require such additional aids no longer. As examples may be mentioned the young shoots of Poplar, Apple, Ivy, etc., while the leaves of Coltsfoot are at first densely villous, but soon lose the cottony webs from the upper surface as they become adult.

Conclusion.—The examples given in this paper could, of course, be multiplied indefinitely; but enough seems to have been stated to justify a belief in the general accuracy of the deduction that vernation, conduplication, the various positions taken up by developing leaves, etc., all conspire to protect them from the evil effects of radiation.

* This is due to the fact, at least in Clover, that a thick layer of chlorophyllaceous tissue is developed over the fibro-vascular bundle of the midrib, thereby preventing the two halves closing again.

† *L. c.* p. 341, fig. 137.

THE URANIA RIPHŒUS.

THIS moth is interesting from two points of view. Firstly, it would be at once pronounced a butterfly, and a very brilliant one, by all persons who are not specialists in insect-lore, and, secondly, because, whilst the individual species in question is peculiar to Madagascar, the other members of the genus Urania are found only in the neotropical region. The Rev. Paul Cambroné, S.J., who has already forwarded to our contemporary, *Cosmos*, an account of this insect in its mature condition, is now enabled to give an account of its caterpillar and chrysalis. He writes:—"M. E. Perrot having lately made a small journey of exploration to Alakaty found some caterpillars of *Urania riphoeus*, which he has forwarded to me. The caterpillar of *Urania riphoeus* is long, and nearly uniformly cylindrical. It is five centimetres in length and about seven millimetres in mean diameter. It is beset with isolated hairs or filaments over its segments, characterised by their spatula-like form, the narrower part protruding from the body of the insect. The legs are sixteen in number, the three anterior pairs being chitinous, and the five posterior membranous pairs being yellow, speckled with black on the outer side. The thick, broad head is also of a yellowish colour, speckled with black. The scutellum is of the same colour as the head. The stigmata are black. The underside of the caterpillar is yellowish. The first segment of the back is yellowish, speckled with black; the second is black, and the nine others are of a yellowish white, also dotted with black. The caterpillar feeds upon a plant called by the natives *hazomalay*.

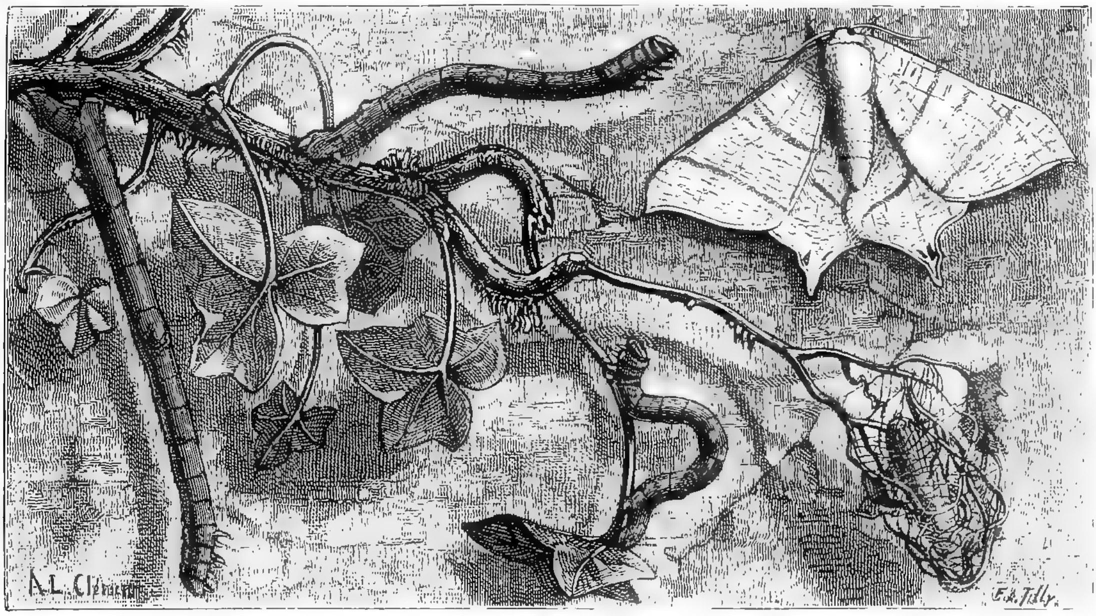
"The caterpillar is transformed into a chrysalis in a cocoon formed of a very transparent tissue of open meshes, around which it collects the fibres of the leaves. The pupa of the *Urania riphoeus*, as in most moths, is rounded, cylindric-conical, and measures about three centimetres in length by eight millimetres in its maximum diameter. It is of a brown colour.

"It remains in the pupa state for a fortnight, and the mature insect issues from its cocoon at midnight. In its perfect state it flies from January to May."

Natural History.

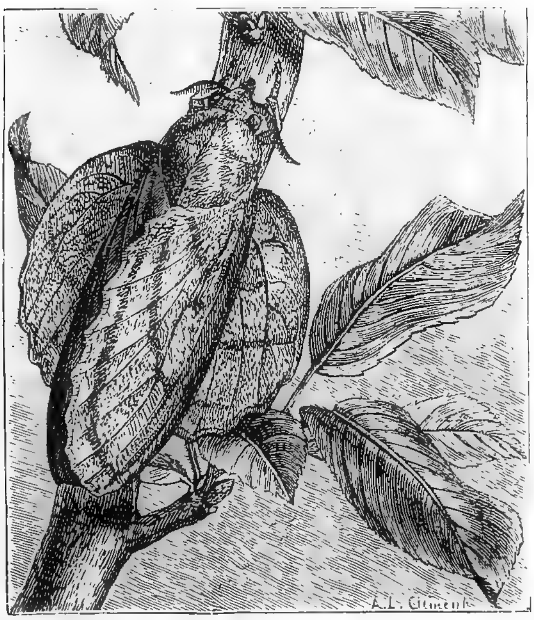
MIMETISM IN ANIMALS.

ONE of the most interesting as well as prevalent phěnomena of the animal world is that which in its



BROWN CATERPILLARS OF ELDER MOTH (*Uropterix Sambucaria*), ASSUMING THE APPEARANCE OF BRANCHES OF THE TREE.

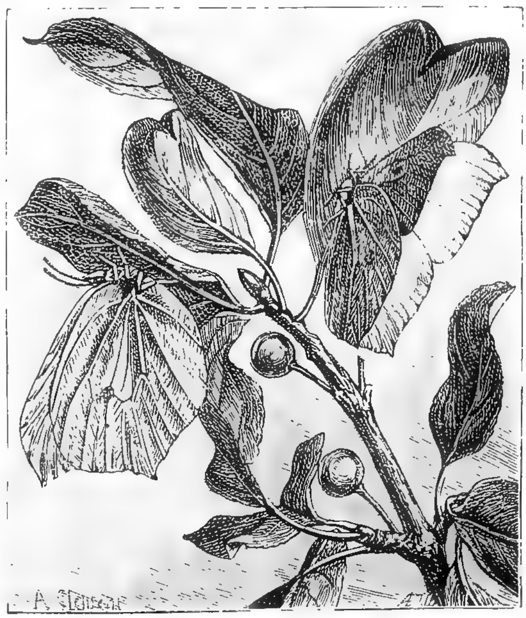
most intensified form is known as mimicry, or mimetism. Multitudes of animals when in their natural haunts are found to bear so close a resemblance to the objects



GONEPTERYX RHAMNI.

with which they are surrounded or in actual contact that, without close scrutiny, they escape being seen. The likeness may be either to some other animal of very different nature or to some plant or part of a plant, or to a portion of lifeless matter. It may further be permanent, depending on the shape and colour of the creature concerned, or it may turn upon some position, attitude, or action capable of being assumed or performed when wanted.

These various forms of mimicry can be more easily rendered intelligible by examples than by any kind ot general description.



LASIOCAMPA QUERCIFOLIA.

One of the most striking cases of mimicry which have lately been brought to light is that of a yellow spider which inhabits flowers in California. This creature spins no web, but catches its prey by surprise. In the region which it frequents, a yellow composite flower, of exactly the same shade as the spider, is very common. The creature accordingly takes up its position in the middle of the flower, where its legs are confounded with the anthers. If, as it frequently happens, a fly or a butterfly alights on the flower, it is at once seized and devoured. At the same time the spider escapes the notice of passing birds. On leaves, tree-trunks, or on a flower of any other colour this spider would be at once seen and avoided by his prey or seized by its enemies.

There is a gaily coloured mantis in Assam and Burma which by the attitudes it assumes deceives butterflies into paying it a visit. The moment they alight on the supposed flower they find themselves in the grasp of their enemy.

No less formidable a creature than the Bengal tiger, conspicuous as he looks on open ground, is, on account of his vertical stripes, very hard to distinguish among the stems of reeds, bamboos, and other jungle plants. The markings of the leopard, which lurks amidst the foliage of trees, are equally adapted for concealment. Every one must have observed that when the sun is shining through the head of a tree the shadow presents the appearance of rounded spots, dark and light intermingled. Thus among the foliage of a tree any animal with eye-like spots, such as the leopard or the jaguar, is not readily detected.

The tiger, in addition to the jungle-pattern of his skin, if we may so call it, has another method of deceiving his intended prey. He can imitate the whistle of the sambur deer with great nicety, and thus sometimes entices these animals to come unsuspectingly within the reach of his spring. The leopard allures a smaller species of deer in a similar manner. But the most numerous cases of mimicry hitherto placed on record are defensive, not offensive. The species in question simulate the colours, the shape, or the movements of some much more formidable creature, and thus escape attack.

The pretty beetle, *Clytus arietis*, not uncommon on old posts and rails in some districts, is very generally taken for a wasp by the non-entomological public, on account of its black and yellow livery. As if aware of its advantage, it does not seek concealment. On the contrary, *Callidium violaceum*, an insect very similar in habits, size, and means of defence, but not mimetic, is exceedingly shy, and on the approach of an observer quietly disappears around a gate-post or underneath a rail.

An admirable case of mimicry is afforded by the caterpillar of the "lobster moth," *Stauropus fagi*. From whatever side this larva is viewed, it has a most uncanny appearance. Four of the anterior legs are very long, and closely resemble those of a spider. If an ichneumon approaches these legs are turned towards her, and moved in a manner like those of a spider when about to seize its victim. The ichneumon having a wholesome dread of spiders, declines the offered embrace, and flits away to find a safer subject into which to insert its egg, and the caterpillar has saved its life by a clever fraud.

But perhaps in the most numerous cases an insect finds its advantage in mimicking a leaf, dead or living, a turf of moss, a twig, a splash of mud, or the droppings of a bird. One of the commonest of these imitations is shown in fig. 1, which we owe to the courtesy of our contemporary *La Nature*.

The caterpillars of the moths belonging to the numerous tribe *Geometra* (loopers, or spanners) attach themselves by their hindmost pair of feet to the branch of a tree, and remain sometimes for hours in an erect position, very closely resembling a dead twig.

Our figure represents caterpillars of *Uropteryx sambucaria*, a very common species, known to lovers of moths as the "swallow-tail" in such attitudes.

Other species display a remarkable likeness to leaves, and be it noted, of the leaves of the trees which they feed upon or frequent. Thus the brimstone butterfly (*Gonepteryx rhamni*), when at rest on a buckthorn bush shows a considerable resemblance to the leaves of that shrub. The lappot moth (*Lasiocampa quercifolia*) when at rest may readily be confounded with a tuft of sere leaves. Even the most gaily coloured butterflies when at rest often remain unseen. The upper surfaces of the wings are hidden by being brought together in an upright position over the insect's back, and it often heels over at a small angle to the horizon, so as to present a less prominent appearance.

Not a few moths contrive to render themselves practically invisible by taking up such a position, *e.g.*, on a papered wall, that their outline may coincide with some line in the design.

There are beetles, especially of the families *Rhyncophori* and *Chrysomelidæ*, which, without very close examination, cannot be distinguished from a crushed berry or the droppings of a bird. Mr. H. Drummond, in his "Tropical Africa," gives an amusing account of his mystification at seeing a white splash on a boulder suddenly, but slowly, begin to move, and how he could scarcely believe his own eyes until he had turned the insect over and detected a head, six legs, and a segmented body.

We, along with not a few naturalists of much higher standing, have occasionally been deluded into picking up some little bit of refuse in the belief that it was an insect.

It will probably be found that instances of mimicry are far more numerous that we are yet aware, and that each has its lesson awaiting the patient inquirer.

But there are evidently some animals, especially insects, unprovided with any arms, offensive or defensive, and not protected by any form of mimicry. But such species, we suspect, are preserved from extirpation by their wonderful fecundity. Accordingly, though the individual falls a victim by myriads to birds, spiders, and carnivorous insects the type survives.

Mimicry is a fine subject for the young naturalist to study, especially if he has the good fortune to take up his abode in a country but sparingly explored.

THE TSETSE.—M. Channon, writing to *Cosmos*, desires to mention facts concerning this dreaded insect which may have a certain interest. "In a journey which I recently made to Zanzibar I had to suffer much from this inconvenient Dipteron. (How many Diptera are other than inconvenient ?) I had to traverse a great plain which extends between the mountain mass of Oukami and that of Ngouron. This plain is dry, barren, and uninhabited, but herds of beasts abound, buffaloes, zebras, giraffes, antelopes of all sorts, and even some elephants have been seen. In all this desert as soon as the sun touched the horizon the Tsetse gave me no rest. It is a truly provoking beast, but to many it is nothing further. Still, I must remark that after these attacks (I have been bitten more than 200 times) I had to suffer from an affection like nettle-rash, which lasted too. At the places where I had been bitten there were raised spots whiter than the skin and occasioning a very intense and unpleasant irritation.

"In another journey, and under similar conditions, I had to suffer from the same affection, which redoubled in intensity at night and completely prevented sleep.

"The most interesting fact is that in this desert, just before the passage of our caravan, the Tsetse had put to rout an army. The Massai, to the north of Zanzibar, constitute a numerous nomadic pastoral tribe extremely dreaded on account of their warlike disposition. This tribe, in the intention of attacking Mrogaro, had encamped in the desert plain which has just been mentioned, having with them a herd of 300 oxen. The people of the country were much alarmed, when they suddenly learnt that the Massai had retired with precipitation. The Tsetse had interfered, and the destruction of their oxen had compelled the Massai to withdraw.

"I have just read that Dr. Laboulbene attributes the effects of the bite of this fly to its settling upon putrid carcases. I doubt whether the experiments which he is about to make will confirm this hypothesis. In any case the difficulty is to explain why the bite is deadly to the ox and not deadly to man."

THE HORSES OF THE PAMPAS.—Sen. J. Solveyra forwards to *La Nature* some interesting information concerning the horses of the Pampas of La Plata. In that region there are three millions of horses of Arab blood, since their progenitors were originally imported from Andalusia. Their peculiar beauty, strength, and staying power are well known, and many of them have been lately purchased for the French army. Mounted upon such horses, good riders have been known to travel 200 kilometres (=120 miles) in twenty-four hours. Races have been instituted at Ayacucho to test the endurance of these horses. The horses were to travel for ten hours; the riders might at pleasure stop, dismount, and go at a walk, a trot, or a gallop. The winner was Recluta, belonging to Sen. Bandrix. This horse travelled in ten hours 143 kilometres, *i.e.*, 88 miles.

A NEW WEED.—A novel pest has appeared in some districts of the State of New York. It is a species of house-leek, known to botanists as *Hieracium pracaltum*, unfavourably known in Europe, and apparently of recent introduction in America. It has there become more rampant, and on account of the annoyance it occasions, it has received the name of the "King Devil." When it once appears in a field it covers the entire surface with its leaves, so that nothing else can grow.

THE DIET OF THE PHEASANT.—A correspondent of the *Field* gives an interesting account of the animal diet of the pheasant. Upwards of 1,200 wire-worms have been counted in the crop of a single pheasant, and in another there were found 440 larvæ of the daddy-long-legs (*Tipula oleracea*), a most destructive insect. From another three young vipers have been obtained. Hence the pheasant, quite independently of its value as food, merits public goodwill and protection.

MISCHIEVOUS INDUSTRY.—Mr. Walter Hough, in a letter to *Science*, mentions that he has caught ants in the very act of transferring scale insects (*Coccidæ*) from one plant to another.

THE TEETH OF WHALES.

PART I.

THERE are very few families of tooth-bearing animals in which the dentition varies so greatly as in the whales. Generally speaking, the dental formula, to use the technical expression, is very much the same in all the members of a given group. There may perhaps be variation in individual species; that is not unusual. But it is seldom noticeable in any great degree. And so true is this as a general rule that in many cases the dental structure is considered, and justly considered, as one of the strongest and most unfailing of family characteristics.

But in the order of the Cetaceans, which comprises the whales and their allies, many ordinary rules are partially or wholly abrogated; and this among them. And there are scarcely any two species whose teeth are of similar character. A whale may have teeth—and almost any number of teeth—or it may have none. If it possess them, they are quite unlike the teeth of other mammals. There is no distinction between molars, canines, and incisors, for all are alike in form and in size. A greater number may be present upon one side of the mouth than upon the other; and, more remarkable, perhaps, still, different individuals of the same species may very possibly exhibit quite a different tooth-armature. Thus it is quite evident that, as far as these animals are concerned, we must not look for family characteristics in the teeth; and the only respect, indeed, in which we can employ those organs for purposes of classification is by dividing all living cetaceans into two great groups, or sub-families, the one comprising those species which possess teeth, and the other those which do not.

I purposely employ the adjective "living" for the good and sufficient reason that in earlier days of the world's history a group of cetaceans existed whose teeth presented very well-marked characteristics, the molars being perfectly distinct from the incisors, and the incisors from the canines. Such were the Zeuglodons, the Phocodons, and the Squalodons, the former of which seem to have dwelt in New World waters, their fossil remains being not uncommonly found in the Eocene and Miocene strata of Northern America, while the members of the two latter genera had a wider range, and have left their relics behind them in most European countries as well as in Australia and the United States. All these, however, have long died out, in company with most of the giants which were on the earth in those days, and our latter-day cetaceans are represented by two groups only, the one of the Denticetes, or toothed whales, and the other of the Mysticetes, or those whose mouths are furnished with whalebone.

Much discussion has arisen over this most curious substance, its nature, affinities, and uses. It is scarcely necessary to state that its title is a most misleading one, and that it has nothing to do with true whale's bone at all; but many have been puzzled by the question as to whether it is, or is not, a modification of the teeth. Not that it exercises any of the ordinary functions of those organs. It is obviously useless for purposes of mastication, and, although it certainly assists in the capture of prey, it does so in a manner very different to that in which the teeth of any other animal are employed. And the material of which it is composed is undoubtedly quite distinct from either bone, dentine, ivory, or enamel, the only four substances which enter into the composition of true and actual teeth. It is, in fact, little or nothing more than a mass of long hairs agglutinated together into a series of plates, some broader and some narrower, fringed at their tips, and set closely side by side. And equally convincing testimony in favour of the argument that it is in no sense a modification of the teeth we find in the fact that it springs, not from the gums or the jaw-bones, but from a layer of vascular substance lying *upon* the former. And, if still further proof than this be required, it may be found in the presence, in certain whales, of whalebone and true tooth-germs together, although these latter are very small and rudimentary, and never project beyond the gums. The mere fact that they are there, however, tells its own story, and effectually disposes of the theory that the whalebone represents them, although in a singularly modified form.

In other words, this whalebone, or "baleen," to bestow upon it the title employed by those instrumental in procuring it, is a special apparatus provided for a special purpose, and not a mere modification of organs which, in all other animals possessing them, are of a widely different character. Yet no account of the teeth of whales would be at all complete without a description of this most curious substance. Although not structurally analogous to teeth, and fulfilling none of the ordinary duties of teeth, it yet takes the place of teeth, and performs a most important duty which no true tooth-apparatus could satisfactorily fulfil. And this duty, as already stated, lies in the capture of prey.

Now, strange as it may seem, and indeed almost incredible, it is nevertheless a fact that the mysticete whales, although numbering among them some of the very largest of all created beings, find their food, and the whole of their food, in the very smallest. They are living exemplifications of the proverb that "extremes meet." And there is a common saying among sailors, and a saying which is strictly and absolutely true, to the effect that a whale sufficiently large to float a jolly-boat in its mouth would yet be choked by a herring. For the gullet of a fully-grown Greenland whale, an animal eighty or ninety feet or so in length, is little more than two inches in diameter! The animal, therefore, which is strictly predacious, must perforce content itself with victims of minute dimensions; and these it finds in the form of certain small marine creatures, such as shrimps, medusæ, and the young of crabs and lobsters, which herd together in enormous shoals, consisting, very often, of many millions of individuals. Now were its mouth of ordinary character the whale would have, and could have, but little success in the chase. One can scarcely imagine a shark or a walrus pursuing such victims, and making a satisfactory meal upon them. But the possession of the whalebone plates enables the whale to do so without difficulty. All that it need do is to open its mouth to the fullest extent, drive at full speed through the shoal, and enclose a vast number of the tiny creatures. Then the mouth is partially closed, and the whalebone forms a close network around its margins, through the interstices of which the water is ejected, while the little prisoners are retained. As soon as the water is expelled the captives are gradually swallowed, and then the process is repeated again and again until hunger is fully satisfied.

The amount of this whalebone, and the length of the plates, of course varies very much in accordance both with the species and with the size of the individual specimen. In a very large whale indeed some of the plates, of which there are about three hundred upon either side of the mouth, may be twelve feet or more in length, and their total weight upwards of two tons. But whales such as this, in these days of persecution, are exceedingly rare, and half that amount is a very fair quantity to be taken from the mouth of a single specimen; more especially as, so lately as 1884, the best whalebone sold at the rate of £2,500 per ton. But this is a somewhat exceptional price, and from £600 to £800 may be quoted as the ordinary rate.

Whalebone of the first quality is only to be procured from one species of whale, viz., the Greenland, or Right Whale; but many other whales possess it. Thus it is present in the Rorqual, that giant of his race, but seldom attains to a length of more than four feet; as there are some eight hundred plates, however, it is still of some little value. It is also found in the Hump-backed, or Bunched Whales, but is generally brittle, and of little service for commercial purposes. And the Pike Whale, Biscay Whale, Japan Whale, and many others possess it, although neither in quantity nor quality sufficient to render their capture desirable.

The true teeth of the whales we must leave for a subsequent paper.

THE PINEAL OR PARIETAL EYE.

In a recent number of the Scientific News, whilst giving an account of the *Pelosaurus laticeps*, we mentioned, amongst the other remarkable features of this extinct reptile, that it shows evidence of having possessed an eye in the middle of the skull, between the two parietal bones. The existence of such eyes in a variety of vertebrate animals has been exhaustively studied by Professor Baldwin Spencer, who made known his remarkable results in a lecture delivered at Sydney during the late meeting of the Australasian Association for the Advancement of Science. Of this lecture we are able to lay before our readers only a meagre outline, as it is not reported in detail in the Sydney papers, and as the proceedings of the Association have not yet been printed. Professor Spencer said that in the brains of the vertebrate animals there exists a small special part known as the "pineal gland." The meaning of this part has been a problem. Among the suggestions propounded one of the wildest was that it must be the seat of the soul. But it is now ascertained to be the rudiment, or we had better say the remnant, of an eye. This part is much better developed in some species than in others. It varies in structure in mammals, birds, and amphibians, in which it is not very highly developed. In lizards and certain fishes it has become transformed into an eye, the pineal or parietal eye.

Professor Spencer explained the gradual development of the eyes in lizards, and the ultimate production of two lateral eyes and one intermediate eye. He then described the structure of the pineal eye in various lizards, especially in *Hatteria* (the tuatera of New Zealand), *Varanus*, and *Chameleo*. The extinct reptiles and amphibians possessed the pineal eye, the use of which has been lost by their descendants, so that in species which now exist this third eye has become a mere rudiment, and as far as we can detect, it does not exert any function.

But a very curious phase of the subject yet remains. It would seem as if this eye had been met with in animals much higher in the scale of creation than lizards. Among various human races there are traditions of men with a median eye, either in addition to the ordinary pair or in their stead, as in the fabled Cyclops. All the old mythologies refer to such eyes. In India the gods, especially Seeva, are adorned with this feature, and to this day it is painted on the foreheads of the dancing-girls. The question at once arises, how have such traditions originated and been handed down? Leaving mankind on one side, we have no specimen of a mammalian skull with the aperture necessary for such an eye to act as a light organ. Yet it is difficult to understand that ancient nations can have invented the existence of such an organ, and have assigned to it the place which it would have to occupy.

FLUORESCENCE AND PHOSPHORESCENCE.

As the terms "fluorescence" and "phosphorescence" often occur in scientific and semi-scientific literature without any satisfactory explanation of the nature of the phenomena to which they are applied, we extract from *Wiedemann's Annalen* the substance of a memoir on the subject by Dr. E. Wiedemann. This physicist points out that we have to distinguish two principal forms of the development of light. The normal production of light ensues when the motion of the molecules of any substance is so intensified by the accession of heat that it occasions luminous vibrations of the atoms of the ether. But in addition to this kind of production of light there is another in which illumination is manifested without any accompanying rise of temperature. Wiedemann proposes for this kind of the development of light the general name *luminescence*, and calls the bodies which possess this property luminescent. Luminescence includes fluorescence, phosphorescence, the electric illumination of gases, and the light produced during certain chemical processes and when certain crystals are slightly heated.

Whilst in normally luminous substances of any given absorptive power the intensity of the luminous vibrations is completely determined by their temperature, this does not hold good in luminescent substances. But we may for comparison speak of a temperature of luminescence for rays of any given wave-length. It is namely that temperature at which the body in question, if heated alone without any external excitement, would send out light of the same intensity as that derived from luminescence. We thus obtain a standard for the strength of the vibrations which produce light as compared with the other existing molecular motions.

As hitherto fluorescence has been observed only in liquids, and phosphorescence only in solids, Dr. Wiedemann proposes a method for converting fluorescence into phosphorescence by the gradual addition of colloid substances.

It appeared in his experiments that nearly all substances which are luminescent in solution by incident light, do the same if their solutions are mixed with gelatine and allowed to dry up. Whilst watery solutions are luminous only during the incidence of light, or in other words are fluorescent, the dried up gelatinous solutions retain their light for a considerable time afterwards, that is, they are phosphorescent. Sulphate of quinine displays this property in a beautiful and prolonged manner. Gelatine to which a little glycerine has been added is distinctly phosphorescent after an admixture of fluorescent substances, as it lies on the boundary between liquids and solids. Experiment therefore shows that a fluorescent body may be rendered phosphorescent by restricting more and more the free mobility of its molecules.

Reviews.

An Introduction to Practical Inorganic Chemistry. By William Gage, F.C.S., F.I.C. London: Longmans, Green, and Co.

If we do not surpass every neighbouring nation in the quantity of original chemical research which we produce, we certainly exceed all the rest of the world collectively in the number of elementary treatises, handbooks, and manuals which we put forth. This phenomenon is not without its difficulties. It may be asked how the authors persuade themselves that there is room for works which cannot and do not contain anything novel in point either of fact or theory? And, again, how are publishers found willing to undertake the issue of these publications? As a rule, these gentlemen are somewhat shy of scientific books. We suspect the solution of the problem must lie in the unhappy character which higher education has assumed in England.

In the little work before us there is nothing to which exception can be taken as erroneous, but, on the other hand, we do not find in it any feature which gives it a marked superiority over its rivals.

Handbook to Breeding, Diseases, Treatment, Care, and Choice of Foreign Aviary Birds, including how to Tame and Teach Birds to Speak, and Chapters on Management, Cages, Seeds, Insect Foods, Pastes, Dainties, etc. By Dr. Karl Russ. (Authorised Translation.) London: Dean and Son.

This little work, which is not written in the most idiomatic English, will prove very useful to those who attempt the establishment or management of an aviary. The author utters a much-needed protest against the cruelties practised in the importation of live birds. The way in which parrots are brought over in confined boxes, neither cleaned nor ventilated, is truly painful. Few of them die on the passage, but many carry in their systems the germs of fatal disease, and perish soon after they have been sold.

EARTHQUAKES.—A severe earthquake was felt in Sikkim on the 9th inst.

THE ECLIPSE OF THE SUN IN 1887.—The Physico-Chemical Society of St. Petersburg has published (*La Nature*) the observations made by Professor Mendelejeff during his balloon ascent at Twer. From photographs obtained on the shore of Lake Baikal, and at the Bay of Possiet on the frontiers of Corea, it appears that the corona is not a simple phenomenon of diffraction, but is produced by objects existing around the sun. A portion of the rays of the corona seems to be connected with the spots and the protuberances of the sun. During the eclipse the barometric pressure was reduced by $\frac{2}{7}$ of a millimetre, owing to condensation in the earth's atmosphere. The thermometer fell 1·6 degs. in the shade, and 8·6 degs. in the sun. The force of the wind was diminished. As to the alleged effects upon the magnetic needle the reports are contradictory.

Abstracts of Papers, Lectures, etc.

ROYAL SOCIETY.

At the meeting on November 15th a paper "On the Mechanical Conditions of a Swarm of Meteorites, and on Theories of Cosmogony," was read by G. H. Darwin, LL.D., F.R.S., Fellow of Trinity College and Plumian Professor in the University of Cambridge.

Mr. Lockyer's recent investigations have led the author of this paper to make a suggestion for the reconciliation of two apparently divergent theories of the origin of planetary systems.

According to the nebular hypothesis the solar system originally consisted of a rotating globe of gas, which, as it cooled, rotated faster, until it became so much flattened that a ring of gas was detached from the equatorial region. This ring then coalesced into a planet, and subsequently other rings were formed, which in their turn became planets.

But notwithstanding the high probability that some theory of the kind is true, the acceptance of the nebular hypothesis presents great difficulties, and other speculators on the origin of the planets have attributed their existence to a gradual accretion of meteoric matter.

The very essence of the nebular hypothesis is the conception of fluid pressure, since without it the idea of a rotating globe of gas becomes inapplicable. Now, at first sight, the meteoric condition of matter seems absolutely inconsistent with a fluid pressure exercised by one part of the system on another. We thus seem driven either to the absolute rejection of the nebular hypothesis, or to deny that the meteoric condition was the immediate antecedent of the sun and planets.

The object then of this paper was to point out that by a certain interpretation of the meteoric theory a reconciliation may be obtained between these two orders of ideas, and it may be held that the origin of stellar and planetary systems is meteoric, whilst the conception of fluid pressure is retained.

It is now well established that a gas consists of minute elastic molecules moving with great speed and continually coming into collision with one another.

According to this so-called kinetic theory of gases, fluid pressure is the average result of the impacts of molecules. If we imagine the molecules magnified until of the size of meteorites, their impacts will still, on a coarser scale, give a quasi-fluid pressure. It is suggested then that the fluid pressure essential to the nebular hypothesis is, in fact, the resultant of countless impacts of meteorites.

Problems involving gases could hardly be attacked with success, if it were necessary to start from the beginning and to consider the cannonade of molecules. But when once it is proved that the kinetic theory will give us a gas which, in a space containing some millions of molecules, obeys all the laws of an ideal non-molecular gas filling all space, the molecules may be put out of sight and the gas treated as a plenum.

In the same way the difficulty of tracing the impacts of meteorites in detail is insuperable, but if such impacts give rise to a quasi-fluid pressure on a large scale, it may become possible to trace out many results by treating an ideal plenum. Laplace's hypothesis implies such a plenum, and it was maintained by the author that this plenum is merely the idealisation of the impacts of meteorites.

The paper contained an examination of the justifiability of the suggestion, but the details are of too special a character to admit of discussion here. The author showed how the actual velocities are determinable of the meteorites which made up the globular swarm from which the sun originated, and he concludes that the collisions between them must have occurred with sufficient frequency to permit us to treat the swarm as in many respects mechanically analogous with a gas, even at a time when it was as widely diffused as the orbit of the planet Neptune.

Messrs. J. W. Largley, M.A., F.R.S., and H. M. Fletcher, B.A., read a paper on the "Secretion of Saliva.' The salivary gland cells pour forth during secretion, water containing in solution various salts and various organic substances, the latter being in the case of the sub-maxillary gland of the dog chiefly mucin. The experiments given in the paper are in the main directed to determining the conditions which affect the rate of secretion of the different constituents of saliva, viz., water, salts, and organic substance.

It has previously been shown (Heidenham and others) that when the chorda tympani — the secretory nerve proceeding from the brain to the sub-maxillary gland—is stimulated, the saliva alters its character the faster it flows. The more rapidly secreted saliva contains a higher percentage of organic substance and within limits a higher percentage of salts. Messrs. Langley and Fletcher confirm the above, except as regards the limit to the increase in the percentage of salts. They find that however rapidly the saliva is flowing, and it can be made (by stimulating the secretory nerve) to flow still faster, the percentage of salts will increase. But each successive equal increase in the rate of flow causes a less increase in the percentage of salts in the saliva. Because of this and because the rate of flow of saliva cannot be indefinitely increased, the percentage of salts in saliva never reaches the percentage of salts contained in blood plasma. In the saliva from the sub-maxillary gland of the dog, the maximum percentage of salts known to occur is ·77, whilst blood-plasma usually contains ·85 per cent. of salts. Since there is reason to believer that the lymph from which the glands secrete also contain about ·85 per cent. of salts, it follows—and this is well known—that the gland cells are able as it were to refuse to take up some part of the salts contained in lymph. The behaviour of the sub-lingual gland of the dog is in striking contrast to the sub-maxillary gland. The sub-lingual saliva contains about 1 per cent. of salts (Werther, Langley, and Fletcher), *i.e.*, it contains a higher percentage of salts than that in blood-plasma.

When pilocarpin—1-10th to 1-20th of a grain—is injected into the blood, a rapid secretion of saliva results. Messrs. Langley and Fletcher find that when a mixture of pilocarpin, lithium citrate, potassium iodide, and potassium ferrocyanide is injected into the blood, lithium can be detected in the first drops of the saliva secreted, the iodide can be detected after the first six drops, and is probably present in the earlier drops, whilst the ferrocyanide cannot be detected in the saliva at any stage of secretion.

It has been said above that the percentage of salts and of organic substance increases as the rate of flow of saliva increases. Messrs. Langley and Fletcher point out that this is only the case under certain conditions. The alterations in the character of the blood, or of the normal blood flow through the gland, modify the percentage composition of the saliva. Thus an insufficiency of oxygen, as in dyspepsia, decreases the rate of secretion of saliva, but the saliva has a higher percentage of salts, and usually a higher percentage of organic substance. Loss of blood also decreases the rate of flow of saliva, but very markedly increases the percentage of organic substance. The dilution of the blood by sodium chloride solution ·2 to ·6 per cent. leads to a much more rapid flow of saliva, but the percentage of salts in this saliva falls, instead of rising. If, however, strong salt solution is injected into the blood, the percentage of salts in the saliva rises somewhat.

It appears then from these experiments that the character of saliva is determined by (1) the strength of the stimulus, (2) the character of the blood, (3) the amount of blood supplied to the gland.

Messrs. Langley and Fletcher point out concerning the theory of secretory nerves, that "nearly all the arguments which have been adduced to prove that the secretion of organic substance is governed by special nerve-films have their counterparts with regard to the secretion of salts, so that we might imagine at least three kinds of secretory films to be present. The experiments, on the whole, indicate that this complicated arrangement does not exist, but that the stimulation of a single kind of nerve-fibre produces varying effects according to the varying condition of the gland cells."

THE INSTITUTION OF CIVIL ENGINEERS.

At the meeting held on Tuesday, the 13th of November, the President, Sir George B. Bruce, being in the chair, the proceedings commenced with the distribution of the medals, premiums, and prizes awarded by the Council at the close of the last session.

A paper on "Friction-Brake Dynamometers" was then read by Mr. W. Worby Beaumont, M.Inst.C.E. The author stated that the indications of any apparatus depending on friction must be as variable as the causes of friction and the conditions affecting it, and hence the value of the measurements, obtained by means of a friction-brake dynamometer, must depend on the completeness with which these causes and conditions were taken into consideration or were eliminated. In a friction-brake, the causes of friction were similar to those which generally obtained in other applications of materials brought into rubbing contact; but the conditions were more variable, and chiefly due to variation in pressure and in lubrication, both being affected by the rate of work-absorption and temperature. The friction-brake dynamometer in nearly all its forms was essentially that devised by Prony. In it the friction between a system of wood blocks and the surface of a wheel rotated by the motor whose power was to be measured, was employed in maintaining a weight, suspended at a point on a horizontal line, level with the centre of the wheel. For most practical purposes, this brake was capable of sufficiently exact determinations of power, ranging from 5 to 200 h.p., but it presented some of the elements of inaccuracy which pertained to the friction type of absorption-dynamometers, especially when used for the measurements of variable powers. For measuring the power of a motor, capable of running at a uniform speed with a constant load, the inaccuracy of its indications might be very small and often quite insignificant. With a truly circular wheel and uniform turning power, this brake gave very nearly accurate results, provided the lubrication was regularly maintained; but slight variations in this respect, due to variation in quantity, quality, and temperature of the lubricant and rubbing surfaces, made it difficult to keep the tension of the strap in strict accord with the total friction necessary to maintain the load at a constant level. The frequent change of this tension by the screws, for the purpose of meeting these variations, introduced further inaccuracy.

A simple form of friction-brake, much used as a dynamometer for testing engines by running them against a known load, consisted simply of a thin iron or steel strap, or a pair of straps, to which were attached a number of blocks of wood. A hook was fastened to the straps for the suspension of the load, and the ends of the strap were connected by a right-and-left-handed screw for the adjustment of the tension on the strap or pressure of the blocks upon the wheel, so as to obtain the necessary frictional grip to carry the otherwise unsupported load. With a truly turned wheel, and with uniform lubrication, this brake would run for hours with a variation of but a few inches in the level of the load, if the engine was of good design and had a proper fly-wheel. The variations from several causes were, however, sufficient to make adjustment by the hand-screw necessary, sometimes frequently. The errors in estimating the work done by the engine, which resulted from these causes, were generally small; but it was desirable to remove them for very accurate tests. It had been with this object that devices, for automatically varying the tension in the belt with the variation in the total friction, had been introduced. At an early date a brake-wheel, with an internal water-channel, was used to avoid the mechanical difficulties which resulted from the heating of the brake-wheel, and the variations due to the heating of the lubricant. One form of automatically-adjusting or compensating brake, suitable for small powers, was due to Mr. Deprez. A simple self-adjusting brake dynamometer had been devised by Mr. J. Imray, M.Inst.C.E. In this, the compensating action was due to the increase in total friction which accompanied increase of circumferential surfaces in contact. A modification of this brake consisted simply of a belt provided with wood blocks, but bearing only on the upper half of the circumference of the wheel. At one end of the strap was the load to be lifted by the motor, and at the other end was a spring under sufficient tension to give rise to enough friction to enable the motor to lift the load. This arrangement was very simple and useful. One of the best known friction-brake dynamometers, fitted with a compensating device, was that designed by Mr. C. E. Amos and Mr. Appold, used for the larger powers by the Royal Agricultural Society. Besides the hand-adjusting screw, it was provided with a compensating lever, by means of which the rise or fall of the load was attended with a decrease or increase in tension on the brake-strap, so that a position of equilibrium was automatically attained without causing inaccuracy in the indications. The compensating action could not, however, come into play except by the rise or fall of the weight from its proper position, and hence the value of the device was confined to its power of limiting that rise and fall. In practice, generally speaking, the adjustment required by means of the screw was as necessary with the compensating lever as without it, and its value might therefore be questioned for this reason alone. A further objection to this compensating lever was that it introduced an element of error, which must be variable almost directly in proportion to the extent to which the lever came into play. With a heavily-loaded brake the error must exist; and with a lubricant which materially lessened the total friction of the wood blocks upon the wheel, it must amount to a considerable part of the whole indicated power, unless adequate allowance was made for it. This allowance had seldom been made. In a better form of compensating brake, designed by Mr. Balk, and used by Messrs. Ransomes, Sims, and Jefferies, the compensating lever was outside, instead of within, the circumference of the brake-strap. It connected the ends of the strap, and to its outer end was suspended a scale-pan, and a weight sufficient to keep the lever floating. This weight became a measure of the tension upon the belt, at least at the parts to which it was attached; but it must be varied with change of condition of the brake-blocks, the lubricant, and the temperature of the blocks and wheel; and it must be taken as acting in favour of the motor. The great advantage of this brake was that the experimenter could always ascertain the actual load, although the tension-lever acted as a compensating lever. There was considerable variation in the scale-weights with the same gross load. This, Mr. H. A. Byng explained, was due to the heating of the brake-wheel. When much heated, more grease had to be used, and in consequence the coefficient of friction was reduced, and the weights in the scale had to be augmented to give more tension in the brake-straps. Figures given appeared to show that the larger the number of revolutions, the smaller the tension for a given total friction, and this inference was supported by experience. Mr. Byng had found that with the higher speeds less weight was required on the scale for a given load, or the higher the speed the less the necessary tension in the brake-belt. By the Balk brake the tension at the ends of the brake-belt was measured directly; and for accurate trials a higher speed was preferred with less gross load, and with a scale-weight below 7 lbs. A water-cooled brake was used by Messrs. Richard Garrett and Sons. The wheel was 5 feet in diameter, and 11 inches wide between the flanges within which the wood blocks ran. An annular trough was formed by internally projecting flanges 3·5 inches in depth. The straight form of Appold compensating lever was employed, though under conditions which seldom, if ever, brought it into play sufficiently to affect materially the accuracy of the indication of the brake. Experiments with this brake showed that the water evaporated in the wheel represented thermodynamically 71 per cent. of the mechanical work done. A brake used by Messrs. J. and H. McLaren had been devised by Mr. Druitt Halpin, M.Inst.C.E. In it the brake-wheel was 5 feet in diameter, and 7 inches in width. Water was constantly supplied to the trough, and constantly taken away by a scoop pipe. Reference was made to a simple form of friction-brake dynamometer, proposed by Professor Thomson, consisting of a cord or rope passed over the upper half-circumference once, or taking one complete turn round a smooth wheel, the one end carrying a load and the other attached to a spring-balance, the rope bearing directly upon the wheel without the intervention of blocks. This brake worked exceedingly well for small powers, and there seemed to be no reason against its use for large powers if a number of separate ropes were used. All the ropes might be attached to a cross-head at either end, from which the weight would hang, and to which the spring-balance could be attached.

The author then proceeded to investigate the tension in the brake-strap, straps, or belt, and the pressure upon the wood-blocks, and considered the effect of the introduction of the Appold compensating lever, with the object of ascertaining whether it was a desirable feature or not. Some information on this point, obtained by Messrs. McLaren, was cited, and the paper concluded with an investigation on this subject, for which the author was indebted to the Consulting Engineers of the Royal Agricultural Society of England.

GEOLOGICAL SOCIETY.

At the meeting held on Nov. 7th, 1888, W. T. Blanford, LL.D., F.R.S., President, in the chair, the following communications were read:—

The Permian Rocks of the Leicestershire Coal-field. By Horace T. Brown, Esq. The Author considers that whilst rocks belonging to the Carboniferous and Trias have been mapped as Permian, true representatives of the Permian do exist in the district to a considerable extent. The Bunter Conglomerates rest for the most part upon the truncated edges of Carboniferous strata; but intercalated between them and the Carboniferous, at various points, are thin beds of purple marly breccias and sandstones, seldom exceeding from 30 ft. to 40 ft., but differing in lithological character from the overlying and underlying rocks. The brecciated series rests with striking unconformity upon the Carboniferous. Moreover, the Boothorpe fault, which throws the coal-measures 1,000 ft., affects the overlying brecciated series to an extent of not more than from 20 ft. to 30 ft. The unconformity between the brecciated series and the Bunter is less obvious. Sections establishing the double unconformity were described in considerable detail. Attention was also called to other localities within the coal-field where Permian rocks exist, the author having in many cases mapped their boundaries.

He further called attention to certain beds which have been erroneously classed as Permian by the Survey. The first of these is a patch at Knowle Hills. Making extensive use of the hand-borer, he found that the greater part of the so-called Permian consists of a wedge-shaped piece of Lower Keuper let down by a trough fault. The so-called Moira grits belong to and are conformable with the ordinary coal-measures of the district.

The Author concluded that the Permian rocks of the Leicestershire coal-field belong to the same area of deposition as those of Warwickshire and South Staffordshire, all having formed part of the detrital deposits of the Permian Lake which extended northwards from Warwickshire and Worcestershire, and which had the Pennine chain on its eastern margin. He pointed out the dissimilar nature of these deposits to those of the eastern side of the Pennine chain from Nottingham to the coast of Durham. There were proofs of the existence of a land barrier, owing to the uprising of the Carboniferous, between the district round Nottingham and the Leicestershire coal-field. He indicated the probable course of the old coast-line of the western Permian Lake. Denudation had bared some of the older Palæozoics of their overlying coal-measures, and it is the rearranged talus from the harder portions of these older rocks which now form the brecciated bands in the Leicestershire Permians.

In an Appendix some igneous rocks found in the Bosworth borings were described.

The President referred to the derivation of the materials of the Permian breccia as an important instance of results due to investigation by local students, and the light thereby thrown on ancient physiography. He was sceptical as to the lacustrine origin of these breccias. Why not subaerial, like those in the interior of Asia? —subangular masses, transported by rainwash to a distance of 10 or 12 miles.

Professor Bonney agreed as to the existence of a barrier of land linking the old area of Warwickshire with Charnwood, and that the breccias did not obtain materials from the Lickey, the east side of which he believed to have been partly covered by coal-measures at that period. The specimens were not exactly of the Hartshill type, and he was prepared to believe that they came from a ridge now no longer visible. He thought, from the nature of the cleavages in the older rocks of Charnwood, that there must have been pre-Carboniferous movements also in that district.

Mr. Whitaker said it was unreasonable to suppose that Conglomerates should always have been derived from exposures now visible. Therefore the alleged underground extensions may easily have furnished these materials. Were the Charnwood rocks of fairly indestructible material?

Professor Blake agreed as to the relations between these beds and the Carboniferous. Was the Permian age so very distinct from that of the Trias? Mr. Wilson regarded the Permian and Trias as really one physical sequence. Are they, then, really separated by such a wide gap? He commented on the appearances at the Swadlincote section. Why might not these Permian beds represent the base of a new epoch? The stones in the deposits on the eastern side were quite different. When the Trias escapes from the Permian it becomes irregular. Were the Coal-basins separated by the Permian movements? If so, the materials dispersed should form the base of the Permian. Is there evidence that these beds belong to a distinct epoch from the Trias, and are not merely its base?

Mr. Topley observed that the main point of the paper was the relation of the beds called Permian to those above and below. The author had well traced out the underground ridge, but what is the evidence of its being a faulted anticlinal?

The Author, in reply, stated that he was not prepared to uphold the lacustrine origin of the breccia; but if subaerial it would make no difference to his argument. With regard to the age of the Charnwood anticlinal, the post-carboniferous movements took place along old lines of disturbance. The scarcity of Charnwood rocks he thought due to the drift having been from the south, and this would help to account for their exceptional abundance at Hartshorn. He had originally been prejudiced in favour of the Permian being the base of the Trias, but found the theory untenable. The material was different from that of the Eastern Permians, and from the material which makes up the basement breccia of the Keuper at Castle Donnington. The maximum angularity of the breccia in the southern part of the area was another point in favour of its derivation from a southern source. As regards evidence of a faulted anticlinal in the subtriassic ridge, the shales were found to be in a smashed condition, and instead of coming to quartzites below, something altogether different was found—appearances which could only be explained on the supposition of faulting.

On the Superficial Geology of the Central Plateau of North-Western Canada. By J. B. Tyrrell, Esq., B.A.

The drift-covered prairie extends from the west side of the Lake of the Woods to the region at the foot of the Rocky Mountains, rising from a height of 800 feet on the east to 4,500 feet on the west, the gentle slope being broken by two sharp inclines known as the Pembina Escarpment and the Missouric Coteau, giving rise to the First, Second, and Third Prairie Steppes.

The Author described the older rocks of this region, referring especially to his subdivision of the Laramie Formation into an Edmonton Series of Cretaceous age, and a Pascapoo Series forming the base of the Eocene, and then discussed the Superficial Deposits in the following order:—

1. *Preglacial gravels* occurring along the foot of the Rocky Mountains, composed of waterworn quartzite pebbles.

2. *Boulder-clay* or *Till,* having an average thickness of 50 to 100 feet, and filling up pre-existing inequalities. The clay is essentially derived from the material of the underlying rocks. The smoothed and striated boulders of the western region are largely quartzites derived from the Rocky Mountains; these gradually disappear towards the east, and are replaced by gneisses and other rocks transported from the east and north-west. Some of the surface erratics of gneissose rock have doubtless been derived from the Till, whilst others are connected with moraine deposits, and others, again, appear to have been dropped from bergs floating in seas along the ice-front. The Till is sometimes divisible into a lower massive and upper rather stratified deposit, separated occasionally by

3. *Interglacial Deposits* of stratified material, with seams of impure lignite, and shells of *Pisidium, Limnœa, Planorbis,* etc.

4. *Moraines,* which are intimately associated with the Boulder-clay, and represent terminal moraines of ancient glaciers which originated upon or crossed the Archæan belt. One of these is the well-known Missouric Coteau.

5. The *Kames* or *Asar* generally occurring at the bottoms of wide valleys, and which resemble in structure those of Scandinavia.

6. *Stratified Deposits* and Beach-ridges which have been formed at the bottoms and along the margins of fresh water lakes lying along the foot of the ice-sheet. The principal of these occupied the valley of the Red River, and has been called Lake Agassiz; it had a length of 600 miles and a width of 170 miles.

7. *Old Drainage-channels.*—Throughout the whole region old drainage-channels appear to have been occupied by southerly running rivers (where the present drainage is northerly), and are considered to have carried away the waters draining from the foot of the ice.

The President spoke of the interest of studying these American deposits. The determination of the age of the Laramie beds by no means did away with the interesting fact of the interstratification of beds containing Tertiary plants with others holding Cretaceous reptiles.

Dr. Hinde remarked that the opinion was formerly held by some Canadian geologists that many of the superficial deposits were produced by marine Arctic currents in a period of depression.

Mr. Topley referred to the rich alluvial deposit filling up the old Lake Agassiz, and its effects upon agriculture. He stated that good alluvial soil occurred along the North Saskatchewan and Peace Rivers, districts which have a great agricultural future. The Laramie coal occurs as pure anthracite in the disturbed districts. He asked whether the flora of a country was not of a later type than the fauna.

PHYSICAL SOCIETY.

At the meeting held on November 10th, 1888, Professor Reinold, President, in the chair, the following communications were read: "On the Calculation of the Coefficient of Mutual Induction of a Helix and Coaxial Circle," by Professor J. V. Jones. In arranging some experiments for determining resistance absolutely by Lorenz's method the author had occasion to consider what form of standard coil was most suitable for accurate calculation, and chose a helix of large diameter, with a single layer of wire. To obtain a sufficient number of turns requires considerable axial length; and Lord Rayleigh's approximate method of calculating the coefficient was found to be insufficient where an accuracy of $\frac{1}{100}$ per cent. is required. A more accurate method of calculation is given which, applied to a circle of 10 ins. diameter, placed concentric with a helix of 20 ins. diameter and 4 ins. long, yielded the value of $M = n.53{\cdot}259$, whereas Lord Rayleigh's formula gives $n.53{\cdot}317$.

Professor Perry asked if the thickness of the wire had been considered, and whether the author could give any information as to practical working formulæ for the mutual induction between the ordinary cylindrical coils in any position.

Dr. Fleming described a wooden anchor ring wound like a gramme armature, and having a secondary coil added, which he had devised as a standard of mutual induction, and used for determining capacity absolutely.

In reply, the author said he had not considered the wire to have thickness, as he felt sure this would not affect the result for his coil by one part in 100,000. With respect to Dr. Fleming's anchor ring, he considered the difficulty of winding it sufficiently uniformly to be a great drawback to its general adoption.

A paper on "The Upper Limit of Refraction in Selenium and Bromine," by Rev. T. Pelham Dale, M.A., read by Mr. Baily. In a former communication (read February 11th, 1888) the author showed that an upper limit of refraction for selenium should theoretically exist about the middle of the visible spectrum, and the present communication describes some experiments which tend to confirm the prediction. On placing a thin, transparent film of selenium under a spectro-microscope, it was found to be opaque to rays above the green, and previous calculations had given 5295·7 as the limiting wave length transmissible.

Sulphur at ordinary temperature should have its upper limit beyond the visible spectrum, but theory indicates that increased temperature will lower the limit. It is well known that sulphur darkens when heated, and when a film of boiling sulphur was examined under the spectro-microscope all but the red end of the spectrum was absorbed. On cooling, the region of absorption gradually retreated towards the violet end.

Selenium is also found to become more transparent as it is cooled, and its refractive equivalent is equal to that of sulphur multiplied by the ratio of its chemical equivalent to its density. Important optical, as well as chemical relations thus exist between the two elements.

The results obtained by bromine films were remarkably similar to those of selenium, the violet rays being entirely cut off.

A method of solving the equation $a \sin \theta = \sin m\theta$ (on the limiting solution, of which the upper limit of refraction depends) by a table of Eulerian integrals is given in the paper, and an analogy between total reflection and the upper limit of refraction is traced.

Professor S. P. Thompson, D.Sc., exhibited some Experiments on Glass in Polarised Light. Irregular pieces of glass can be tested for internal strain by immersing them in a liquid of equal refractive power. Various specimens of tubing, rod, and thermometer tubes were examined in this way, all of which showed defective annealing. One piece of ordinary rod bent zig-zag produced remarkable effects when rotated in the liquid. Prince Rupert's drops, a glass wedge, and a model of the "Regency diamond" showed vivid colours, and the stems of broken incandescent lamps exhibited various degrees of annealing.

Mr. Hilger wished to know whether parallel plates had been tested, and with what result, for he had always found pieces of shapes approaching to roundness, to show greater defects than parallel plates. For this reason he always cut his prisms and lenses from rectangular blocks.

Mr. Blakesley said that no perfectly annealed thermometer had been shown, and he was anxious to know whether any existed.

Mr. Wilson expressed a doubt as to whether it was possible to anneal anything so as to be perfectly free from internal strain, and thought the act of breaking rods and tubes necessarily introduces strains.

Professor Rucker asked whether the usual method of detaching a mercury column for calibrating thermometers produced any injurious effect, but the author was unable to speak decisively on the subject.

In answer to the President, Dr. Thompson said the liquid used was a mixture of carbon bi-sulphide and alcohol. His experience with parallel plates coincided with that of Mr. Hilger. As an example of the remarkable effects which could be produced in glass by various methods of cooling, he directed attention to the fact that Professor Esener, of Vienna, had produced lenses having plain faces.

Dr. J. A. Fleming, M.A., described a new form of standard resistance coil. Considerable difficulty had been experienced with coils of the ordinary B.A. construction when immersed in water or melting ice, due to leakage across the paraffin wax caused by condensation of moisture. To overcome this, various forms have been tried, and the best yet devised is made by winding the coil in the space between two shallow annular casings screwed together by projecting flanges. The joint is formed by indiarubber, and can be tested for leakage by immersing in water and applying air pressure through a small testing-tube. The rising part of the terminal rods are enclosed in long brass tubes soldered to the upper casing and insulated by air, excepting at the top and bottom, where ebonite rings are placed. The top ring forms a corrugated cap, and an annular channel in its upper surface serves as a fluid insulator. The wire, which is triple silk covered, is baked for some hours at a temperature above 100° C., and then soaked in anhydrous paraffine wax containing about 3 per cent. of resin.

ENTOMOLOGICAL SOCIETY.

At the meeting held on November 7th, 1888, Dr. D. Sharp, F.L.S., President, in the chair, Mons. A. Wailly exhibited a large and interesting collection of butterflies recently received from the Gold Coast and other parts of West Africa. The collection included about forty-seven species belonging to the genera *Papilio, Diadema, Salamis, Romalœosoma, Charaxes, Harma, Eurypheme, Junonia, Aterica, Hypanis, Eurytela, Mycalesis, Cyrestis, Nepheronia, Mylothris, Belenois,* etc. Mons. Wailly stated that several of the species were undescribed, and were not represented in the British Museum collections.

Mr. Jenner Weir exhibited four bred specimens of ant-lions, two of which were from Saxon Switzerland, and the other two from Fontainebleau. He stated that that he believed the specimens belonged to two distinct species. Mr. M'Lachlan said that the specimens all belonged to one species, viz., *Myrmeleon formicarius,* Auct. = *Europœus,* M'Lach.

Mr. W. C. Boyd exhibited an example of *Pterophorus zetterstedtii,* taken at Sydenham. He remarked that this species had hitherto only been recorded from Lynmouth and Folkestone.

Mr. Enock exhibited specimens of *Cecidomyia destructor* (Hessian fly), illustrating the life-history of the species, and made remarks on them.

Mr. Wallis Kew exhibited a specimen of *Dytiscus marginalis* having a small bivalve shell attached to one of its legs. The bivalve had apparently attacked the *Dytiscus,* and refused to relax its grasp.

Mr. W. E. Nicholson exhibited several specimens of *Acidalia immorata,* Linn., caught by him near Lewes. Mr. Jenner Weir remarked that the species had only recently been added to the British list, and that it was remarkable how so comparatively large a species could have been hitherto overlooked. It was also remarked that a specimen of this species from the collection of the late Mr. Desvignes had been exhibited by Mr. Stevens at the meeting of the Society in November, 1887.

Dr. Sharp exhibited a large number of species of Rhynchophora, collected by Mr. George Lewis in Japan.

Mr. F. P. Pascoe read a paper entitled "Descriptions of New Longicorn Coleoptera."

Dr. Sharp read a paper on "The Rhynchophorous Coleoptera of Japan."

LIVERPOOL GEOLOGICAL SOCIETY.

At the meeting held on November 13th, the President (Mr. H. C. Beasley) in the chair, Dr. C. Ricketts, F.G.S., described some interesting specimens of liassic fish remains and other fossils from fissures in the carboniferous limestone at Holwell, near Frome, obtained by him during the recent meeting of the British Association at Bath. Mr. O. W. Jeffs then exhibited an old atlas, kindly lent by Mr. E. K. Hayward, dated probably about 1720, and engraved by Tobias Conrad Lotter, of Augsburg. The features of the maps consisted in the principal meridian being taken from Teneriffe, and the delineation of the great lakes of Africa (supposed to have been only recently discovered), which are placed in their approximate positions as feeders of the Nile. In the map of Great Britain, Liverpool was not shown, but small places like Par and Leigh, near St. Helens, were duly marked.

A paper by Sir James Picton, F.S.A., entitled "Notes on the Local Historical Changes in the Surface of the Land in and about Liverpool," was then read. Sir James first called attention to a series of maps illustrating the topography of the neighbourhood. These were of various dates, the oldest representing Liverpool in 1650, and showed the gradual extension of the docks and buildings and development of the inhabited portion of the region depicted. He then proceeded to explain how the cultivation of the land, draining of the marshes, improvement of watercourses, and construction of canals and railroads have imparted to the country an entirely different aspect to its natural character. Geology showed the effects of natural forces, ever at work, in altering the surface-contour of the land, and these changes were often aided by the direct operations of man. Since the foundation of Liverpool there had been many changes in its superficial contour well worthy of notice. At the close of the glacial period the landscape on the eastern side of the Mersey presented a picturesque aspect, resembling the rocky slopes of Bidston Hill on the opposite side of the river, and the high lands at Everton, Low Hill, and Edge Hill were broken up into crags and precipices with deposits of clay in the hollows. This declivity was interrupted by two ancient sea margins, referred to by Mr. Robert Chambers, one of which was stated to occur near the summit of William Brown Street. The upper sea margin constituted the flat ground at the foot of Low Hill, on the summit of which was a pre-historic tumulus. The author gave a mass of topographical detail of an interesting character, in the course of which he referred to the old Moss Lake and other physical features which have long become obliterated. On the subject of the post-glacial geology of the two basins of the rivers Dee and Mersey, Sir James occupied an important portion of his paper, and called attention to one or two aspects not usually considered by geologists. He claimed that the valley of the Dee had for many ages been undergoing a process of shallowing and silting, and that the channel of the Mersey had been gradually deepening. Thus, whilst one valley was sinking, the other had been gradually rising, such diverse action going forward in two estuaries so near to each other being a very remarkable phenomenon. The globe which we inhabit was not a mere inert mass; forces of elevation or depression were continually in progress. The greater or less depth of water in a river channel might change the entire course of commerce, and affect the welfare of millions. It was necessary, therefore, to watch these processes of nature, and aid by science and skill whatever makes for the benefit of our race and age.

A long discussion followed the reading of this paper, in which Messrs. T. Mellard Read, F.G.S., G. H. Morton, F.G.S., W. Hewitt, B.Sc., C. Potter, Rev. S. Gasking, and Dr. Ricketts took part.

ROYAL HORTICULTURAL SOCIETY.

At a meeting of the Scientific Committee, on November 13th, a report was read on the "Jensen System of Moulding Potatoes."

During two successive seasons elaborate experiments and careful observations were made as to the effect of the Jensen system of moulding. The experiments were made at Chiswick under the superintendence of the Scientific Committee. Although results of considerable practical interest were obtained, yet the primary object of the experiments was frustrated by the non-appearance, or rather, by the scanty development, of the Potato-mould. Moreover, it became apparent that the cost of the experiments, as then carried out, would be such as to preclude their imitation on a large scale for practical purposes.

During the present season the potato disease set in at Chiswick with virulence about July 29th. Up to that time no attempt had been made to check its course or to note the conditions under which it occurred; but, at the suggestion of Mr. Plowright, two rows in juxtaposition were submitted to experiment on August 10th.

The rows were 30 yards in length, the variety selected Schoolmaster, and the conditions as absolutely identical as possible, except that the one row was left moulded in the ordinary way, while the other was "high moulded"—that is to say, banked up on one side to form a ridge, while the haulm was slightly bent over to the other side. In the ordinary system of moulding, a furrow is left along the top of the ridge into which it is surmised that the spores fall, washed off by rain from the foliage. The high moulding, it is supposed, obviates this by securing the fall of the spores on the ground between the rows, and not on the rows themselves. As the disease appeared to be equally severe on both rows, and was, moreover, far advanced, but little expectation was indulged in that the results would be of any value.

Nevertheless, on September 29th, the potatoes in the two rows were lifted and examined, as dug, by Mr. Barron and Dr. Masters. It speedily became apparent there was a considerable difference between the two rows, and that the tubers from the high-moulded row afforded a much cleaner and more even sample. With a view to put this general impression to a numerical test, fifty tubers from each row were taken indiscriminately, twenty-five by one observer, the remainder by the other, so as to equalise, as far as possible, the "personal equation."

These hundred potatoes were then examined with a more careful scrutiny, each one being cut open to ascertain whether or no it was diseased. The result was as follows:— Out of fifty taken from the row moulded in the ordinary way, thirteen were found diseased, or 26 per cent.

Out of fifty taken from the high-moulded row five only were noted as diseased, or ten per cent. No doubt a more careful examination by the microscope would have indicated a larger proportion of disease in each case, but it is not likely that it would have very materially altered the proportion either in one direction or the other. In order, however, to obtain further information upon this point, twenty-five tubers from each row were put aside for future examination.

Bristol Naturalists' Society.—At the meeting held on November 6th, Dr. Dallinger delivered a lecture on "Putrefactive Organisms." The Rev. T. Hinks, F.R.S., President of the Society, occupied the chair. The lecturer, who was most cordially received, said his chief embarrassment was the abundance from which he had to select. He should, however, not dwell on the method by which he had pursued his inquiries, or the results of labours undertaken with the vastly improved means of later years compared with those with less perfect instruments, but would detail to them one of the most remarkable results that had been brought out by him in his investigations. Passing to the main point of his subject, the lecturer said the larger of the group of minute organisms with which he should deal were so small that in a square box, having the diameter of a human hair for each of its sides, a hundred millions of these organisms could easily exist. Some of them, however, were five, ten, and even twenty times less than these. If a drop of animal or vegetable matter under putrefaction were placed in a small quantity of pure water, and was inspected with the microscope, organisms of beautiful forms were seen moving about in ceaseless activity. Dealing with the organisms themselves, he explained that various species followed each other as the process of putrefaction went on, each preparing that pabulum on which its successor lived, and spoke of the marvellously rapid rate of their reproduction. Pictures were shown illustrative of the characters of the organisms and the method by which they did their work—some by rising up and darting down on the putrefying mass and tearing it with hooks, others by bringing their weight upon it and acting as hammers. So this unceasing change and activity went on until the putrefaction was exhausted, when the mass, in the shape of carbonic acid and water, became part of the protoplasm of living things once more. Occasionally the deposit or *debris* of exhausted fermentation became subject to further fermentive action, particularly in warm climates, and the tiny organisms, by their continuous rising and striking down and twisting, absorbed in themselves and dissipated the *debris*. In conclusion, the lecturer urged the young members to studiously pursue microscopic or kindred studies, from which they would derive unspeakable pleasure and profit.

The Leeds Naturalists' Club and Scientific Association.—At a recent meeting held at the Yorkshire College, the President (Professor L. C. Miall, F.L.S., F.G.S.) presiding, the evening was devoted to "Practical Microscopy," when, under the direction of the President, the process of preparing and mounting animal sections in celluloidine was fully elucidated, this forming a supplement to an evening on the same subject some three or four weeks ago. On this occasion the object under treatment was the "Honey Bee," which presents several difficulties over animals of softer bodies, as the chitinous integument and the two large air sacs on either side of the body offer a firm resistance against the celluloidine penetrating the internal tissues; but by disconnecting the head, thorax, and abdomen and careful manipulation, the fluid celluloidin can be got to permeate and render the object sufficiently solidified to allow it being cut into sections by the microtome. This was demonstrated with the most encouraging result before the members, transverse sections being made through the head, and sections through the abdomen were mounted and examined. An interesting description of some of the important features of the slides was given. After the demonstration, the President gave a comprehensive lecture on the entire process, commencing with the mode of killing the object, passing on to subsequent methods of treatment and the reagents necessary.

Royal Botanic Society.—At the meeting held on Nov. 10th, Mr. J. P. Gassiot, Vice-President, in the chair, among other exhibits upon the table were plants of *Abrus precatorius*, the so-called "weather plant." The Secretary, in explaining the action of the plant, said he could not do better than quote his respected friend, the late Michael Faraday, who, during a lecture on table-turning, remarked that effects noticed were often incorrectly attributed to a certain cause, and thus the movement of the table was ascribed to some mesmeric influence rather than to the unconscious mechanical act of the operator; and thus the action of the weather plant was put down to atmospheric or other influences at a distance of time or place rather than that of the immediate habitat in which the plant might be at the moment.

behaviour of the weather plants in the Society's lens varied at one and the same time, according to special conditions under which they were growing.

Liverpool Astronomical Society.—At the meeting l on November 12th, Mr. W. H. Davies, F.R.A.S., in chair, the Secretary read a paper on "The Limits of Stellar Universe," by Mr. W. H. S. Monck, M.A., .A.S., which excited a very interesting discussion. aper on "Micrometrical Measures of 200 Double s," by Mr. Kenneth J. Tarrant, was next read. A t interesting report, by Mr. W. F. Denning, .A.S., on "Observations of Jupiter during opposition 887-8," was also read.

RECENT INVENTIONS.

e following list has been compiled especially for the SCIENTIFIC *'s by Messrs.* W. P. THOMPSON *and* BOULT, *Patent Agents, of High Holborn, London, W.C.; Newcastle Chambers, Angel Nottingham; Ducie Buildings, Bank Street, Manchester; ', Lord Street, Liverpool.*

ondensing Gases.—Mr. D. Herman has patented ensers or towers, for condensing acid and corrosive s. It consists essentially in constructing the con- ers of a series of glass pipes carried by bearers, each having at one end an external flange, and at the r an internal flange, the whole being placed in a ble casing. The ends of the pipes having internal ;es are made of less diameter than the ends having rnal flanges, so that the pipes may be fitted one in the other.

bmarine Cables.—Mr. R. Haddan has patented ns for the insulation of submarine telegraph cables other electrical conductors on behalf of Herr E. G. witz. The invention consists in covering the cable strips of tinfoil having on the side towards the a comparatively thick coating of powdered glass, on the tinfoil by a suitable adhesive substance. layer is further covered with a layer of caoutchouc ised in incombustible impregnated silk or other rial according to requirements.

stons.—Mr. P. W. Williams has patented a piston single acting vertical engines. The object is to ly remove the fluid which condenses in the cylin- The top of the piston is therefore made with an ied surface sloping downwards, so that the parts of piston which are contiguous to the exhaust port are lowest, whether the port be in the cylinder or in the n-rod. The result is that the fluid collecting on the top f the piston runs down to this point, and is blown out immediately the exhaust port is opened.

ring Jack.—Messrs. A. Coleman, H. F. Jackson, and E. L. Dudley have patented a spring jack for tele- ic and other electrical purposes. The object is to de means for ensuring proper electrical connections een the spring slipper, in ordinarily constructed g jacks, upon the removal of the plug, even though pring may fail to bear properly on the slipper. This tained by the provision of a secondary spring, which ed at its forward end permanently in contact with the slipper, and, when the plug is not inserted within the jack, bears up at its hinder end against the under side of the main spring.

Electric Accumulators.—Mr. A. Stetson has patented an electrical accumulator. A thin case of lead is formed, into which is introduced the peroxide of lead or active material. To allow access of the liquid in the battery to the peroxide, the case has holes punched through it and the peroxide. The puncturing is so done that small pieces of lead will be partially detached and bent inward to retain the peroxide in the case. On charging the accumulator, these pieces of the lead case and the edges around the holes will be converted into peroxide, so that the case and the plate will be chemically united.

Spinning Machines.—Messrs. H. Whitwam and H. Taylor have patented a method of stopping spinning and other machines. When this invention is applied to a mule a band running the length of the machine is employed and placed on the front of the carriage; this band is connected to and supports a piece of metal near the "head-stock" of the mule. A slot is made in this piece of metal, through which passes a wire running alongside the head-stock and holding a lever which is connected to the strap-guide which moves the strap from the fast to the loose pulley, or *vice versa*, for stopping or starting the machine.

Trimming Specimens.—Mr. F. H. Butler has patented an apparatus for cutting and trimming specimens of rocks and minerals. It consists of a cast-iron base with a head-stock at each end, connected by two rods with nuts at their ends. One head-stock is grooved on its inner face and perforated to receive spanner bolts to hold the cutter; the other head-stock carries a screw with a lever through its head. On the rods connecting the head-stocks is a movable poppet head with the cutter, which is propelled by the screw passing through the second head-stock. For cutting large stones two or more screws may be used, working simultaneously by means of cogwheels.

Electrical Currents.—Mr. W. H. Douglas has patented a meter for measuring electrical currents. It consists in creating heat in proportion to the current by resistance in the coil, and placing in near proximity thereto a thermometer which will, by indicating the temperature, show the intensity of the current, the normal temperature of the atmosphere being indicated by another thermometer, so that the difference between the registration of the movements of the two thermometers will indicate the intensity of the current. To obtain a permanent registration a strip of paper is employed which is moved by a motor upon which the hands of the thermometers are made to leave a record.

Chlorine.—Messrs. L. Mond and G. Eschellmann have patented a process for the manufacture of chlorine from hydrochloric acid or ammonium chloride by means of magnesia, and its object is to prevent the retrograde formation of hydrochloric acid. For this purpose a certain amount of a fixed alkaline chloride is mixed with the magnesia before it is treated with hydrochloric acid. The quantity requisite is about 5 to 10 per cent. of the magnesia. If the magnesia be then treated with hydrochloric acid, magnesium chloride, steam, and ammonia gas are formed. This chloride is then treated to set free all the chlorine, in such a manner that by employing the mixed magnesia and alkaline chloride, no water is absorbed by it, all the chlorine is obtained as such, and free from hydrochloric acid.

ANNOUNCEMENTS.

The Intercolonial Publishing Company, Limited.—Publishers of the *Eastern, Australasian, and South African Journal of Commerce*, and of the *Periodico de Espanol, Mejicano, y Sud-Americano* have removed to Intercolonial House, 131, Leadenhall Street, E.C. The new premises contain large reading, reference, and conference rooms for the convenience of merchants and others visiting London, and provide a centre from which all information upon matters of British, colonial, and intercolonial trade may be obtained free of charge to clients and correspondents.

Worcester.—Dr. Nicol (Mason Science College, Birmingham) gave the second of the series of science lectures arranged for by the Worcester Students' Association on November 9th. The subject was "The Chemistry of Combustion," and it was illustrated by a number of interesting experiments.

DIARY FOR NEXT WEEK.

Friday, Nov. 30.—Greenock Philosophical Society. — *Earthquakes, Volcanoes, and Geysers*, by Commander Charles Reade, R.N., London.

SELECTED BOOKS.

Elementary Commercial Geography. A Sketch of the Commodities and Countries of the World. By H. R. Mill, F.R.S.E., Lecturer on Commercial Geography in the Heriot Watt College, Edinburgh. London: C. J. Clay and Sons. Price 1s.

On the Senses, Instincts, and Intelligence of Animals. With Special Reference to Insects. By Sir John Lubbock, Bart., M.P. With 100 illustrations. London: Kegan Paul, Trench, and Co. Price 5s.

A Class-Book of Elementary Chemistry. By W. W. Fisher, M.A., Demonstrator of Chemistry, Oxford. London: Clarendon Press. Price 4s. 6d.

Kirke's Handbook of Physiology. Twelfth edition. Thoroughly revised and edited by W. Morrant Baker, F.R.C.S., and Vincent Dormer Harris, M.D. London: J. Murray. Price 14s.

An Elementary Treatise on Geometrical Optics. By R. S. Heath, M.A., Professor of Mathematics in Mason Science College, Birmingham. London: C. J. Clay and Sons. Price 5s.

The Principles of Agricultural Practice as an Instructional Subject. By J. Wrightson, M.R.A.C., F.C.S., etc., Professor of Agriculture in the Normal School of Science and Royal School of Mines, etc. With Geological Map. London: Chapman and Hall, Limited. Price 5s.

NOTICES.

The Title Page and Index to Vol. I., now ready, price 3d.

Binding Cases for Vol. I., price 2s. each.

Cases and Binding, Vol. I., including Title Page and Index, price 3s.

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The Back Numbers of Scientific News can be obtained from all Booksellers and Newsagents, or direct from the Publisher, 138, Fleet-street, London, E.C. Price 3d. each, or by post 3½d.

METEOROLOGICAL RETURNS

for the ten weeks ending on Monday, Nov. 12th, 1888. Specially prepared for Scientific News from official reports.

	Mean Temperature.	Rainfall.	Duration of Sunshine.
Scotland, East	47·9 degs., being 0·1 degs. below average.	4·4 ins., being 3·0 ins. below average.	192 hrs., being 36 hrs. below average
England, N.E.	48·3 ,, ,, 1·1 ,, ,, ,,	4·2 ,, ,, 2·3 ,, ,, ,,	208 ,, ,, 1 ,, above ,,
England, East	49·2 ,, ,, 2·5 ,, ,, ,,	3·8 ,, ,, 2·6 ,, ,, ,,	267 ,, ,, 16 ,, ,, ,,
Midlands ...	48·2 ,, ,, 2·5 ,, ,, ,,	4·5 ,, ,, 2·6 ,, ,, ,,	231 ,, ,, 2 ,, ,, ,,
England, South	50·7 ,, ,, 1·6 ,, ,, ,,	5·8 ,, ,, 1·2 ,, ,, ,,	274 ,, ,, 34 ,, ,, ,,
Scotland, West	48·6 ,, ,, 0·4 ,, ,, ,,	6·1 ,, ,, 4·8 ,, ,, ,,	198 ,, ,, 21 ,, below ,,
England, N.W.	49·2 ,, ,, 1·8 ,, ,, ,,	5·1 ,, ,, 4·0 ,, ,, ,,	223 ,, ,, 7 ,, above ,,
England, S.W.	49·9 ,, ,, 1·3 ,, ,, ,,	7·4 ,, ,, 3·3 ,, ,, ,,	288 ,, ,, 19 ,, ,, ,,
Ireland, North	50·4 ,, ,, 0·5 ,, ,, ,,	4·9 ,, ,, 3·4 ,, ,, ,,	187 ,, ,, 24 ,, below ,,
Ireland, South	50·8 ,, ,, 0·7 ,, ,, ,,	6·0 ,, ,, 2·7 ,, ,, ,,	236 ,, ,, 9 ,, ,, ,,
The Kingdom...	49·3 ,, ,, 1·2 ,, ,, ,,	5·2 ,, ,, 3·0 ,, ,, ,,	230 ,, ,, 11 ,, ,, ,,

Scientific News

FOR GENERAL READERS.

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CONTENTS.

SCIENTIFIC TABLE TALK.

By W. Mattieu Williams, F.R.A.S., F.C.S.

On page 486 of the current volume of this magazine is a review of the proceedings of the Royal Society of Edinburgh, concluding as follows: "Prof. R. Wallace communicates a memoir on the 'Colour of the Skin of Men and (Lower) Animals in India.' The author notes that in India cattle, sheep, pigs, buffaloes, and horses, whatever the colour of their hair, have black skins, and of this fact he seeks an explanation."

An explanation was offered by Surgeon-Major Alcock, in a paper published in *Nature*, August 21st, 1884, which has not received the attention that I think it deserves. The title of the paper is, "Why Tropical Man is Black."

After enumerating some of the theories that have been expounded by physiologists in struggling with this problem, he states his own, which summarily expressed is "that the black skin of the negro is but the smoked glass through which alone his wide-spread sentient nerve-endings could be enabled to regard the sun."

The well-established law that surfaces of given material exposed to the solar rays become heated in proportion to their darkness of tint has rendered the colour of the negro an apparent physical paradox. The demand for coolness under tropical sunshine should give such advantage to the white man that under conditions of primitive nakedness he would have there survived as the fittest for such conditions.

This conclusion, however, is based on reasoning that only includes one of the factors of the problem, viz., the *heat* of the solar rays. The experience of shampooers and other attendants in Turkish baths shows that men may be continually exposed to higher temperatures than those prevailing in tropical countries without suffering any injury to health, or even any inconvenience. Many of our English workmen do heavy work in temperatures exceeding that of the Sahara. During the hot summer of 1868 I was engaged in making experiments in the reheating and other furnaces at Sir John Brown and Co.'s works, Sheffield, and carried a thermometer, which I suspended in various places where the men were working. Where I was chiefly engaged it stood at 120 degs. with the furnace-doors shut. The men were exposed to much higher temperatures from radiant heat when charging and withdrawing the great armour-plate piles—over 200 degs. At enamelling works and at glass works the temperature is still higher; 145 degs. is a common temperature in the stoke-holes of steam-packets in the Red Sea. Such work is, of course, exhausting, but not injurious; such temperatures are enjoyable when no muscular efforts and no clothing are demanded, as in a Turkish bath.

On the other hand, at the Creusot Steel Works, where an electric furnace is used which gives out a light of 100,000 candles, the men who are exposed to the glare at a distance of ten or twelve yards suffer severely, though the heat is but nominal. They have to work with great caution and intermittently. Nevertheless, after such intermittent exposure of one or two hours, the effect is "a painful sensation in the throat, face, and temples, while the skin assumes a copper-red hue." The *British Medical Journal*, from which I quote this, describes other symptoms, including a discharge of tears, in spite of using coloured spectacles, which is "very copious for twenty-four hours. Simultaneously headache and sleeplessness are experienced, which are caused partly by the copious discharge of tears and partly by pain and the feverish state of the body. Finally, during the next few days the skin of the face begins to peel off." These and the irritation of the pupil of the eye, lasting for forty-eight hours, followed by "a very painful sensation, as if some foreign substance were introduced under the eyelids," are symptoms quite familiar to myself and others who have exposed themselves to the glaring light reflected from mountain snow in summer-time. I have suffered a complete peeling off of all the skin of face and ears, *i.e.*, of all the skin exposed to the snow-glare.

What, then, would be the condition of the Creusot workmen or the Alp climbers if the whole surface of skin were exposed?

The seat of all this irritation is obviously not in the cuticle, which is merely a protective covering of the body, as insensible as the hair and finger-nails. But immediately beneath it is the *cutis vera*, the true skin, a membrane involving so close and intricate a tissue of nerves and blood-vessels that we cannot insert a needle-point without doing violence to a nerve-ending and rupturing a blood-vessel, *i.e.*, without pain and bleeding.

The cuticle is translucent, quite as translucent as the plates of horn used as the windows of old-fashioned lanthorns. The blush of the cutis is visible through it. A multitude of other facts besides those stated above might be cited to show that the tissue of nerves and blood-vessels constituting the cutis is painfully sensitive to the action of light exceeding a moderate degree of intensity.

Our most advanced physiologists now regard vision as a specialised skin function that has been gradually developed and concentrated in the organs of sight; that the optic nerve which now sees has been evolved from skin nerves that originally could only feel. This conclusion has been reached by observations on animals which display by comparison a gradual process from localised skin-vision to rudimentary eyes, and onwards to fully differentiated optical apparatus.

Earthworms, for example, as proved by Darwin, although without eyes, distinguish readily between light and darkness, and this power is only possessed by the anterior portion of the animal. Examples of the progress from this to the rudimentary eyes of the medusa, starfishes, etc., are quoted in Surgeon-Major Alcock's paper.

The carbonaceous colouring-matter of the negro is situated in what Malpighi called the *rete mucosum*, or mucous net-work, which constitutes the inner basis of the cuticle or epidermis where the horny cells of the cuticle are formed. This is just where such opaque matter is required for protecting the sensitive nerve-endings of the true skin from the injurious action of excessive sun-glare.

The position and known functions of the iris appear to me to present another argument in support of this theory. At the back of the eye, in a position corresponding to that of the true or under-skin, we have a similar membrane, similarly including a tissue of outspread nerve-endings, those of the specialised optic nerve. In front of this we have the cornea, corresponding to the cuticle, between them the iris. The work performed by the iris is that of a dark, adjustable screen, which admits the quantity of light demanded for the purposes of vision, but excludes any excess that would produce painful and mischievous nervous irritation. The colour of the iris varies, like that of the skin, with the original habitat of the races of men. The tropical races have dark eyes as well as dark skin. Those of higher latitudes have light eyes and skin.

This variation proceeds regularly up to a certain latitude, and then comes a remarkable and very suggestive exception. The arctic races, the Esquimaux, the Lapps, or Finns, and the "Hyperborean," or Mongolian races generally have dark eyes, "are olivaceous in colour, the skin varying from a kind of sallow lemon peel through various shades of greater depth, but is never entirely fair nor intensely swarthy" (Colonel Chas. Hamilton Smith, "The Natural History of the Human Species").

Why this exception? My answer to this question is that it fits these people to endure the snow-glare to which they are exposed during more than the first half of their long summer daylight.

They have migrated very widely even to sub-tropical and tropical regions, and there they have more or less dispensed with clothing and have readily developed a darker skin. The Papuans and black Kalmucs are examples of this.

Canals of Mars.—An American exchange states that Professor Pickering, of the Harvard College Observatory, regards the so-called "canals" of Mars as areas of vegetation—possibly immense cultivated tracks.

ROMAN REMAINS AT LLANTWIT-MAJOR.

(*Continued from p.* 502.)

PERHAPS the discovery of most general interest is the room numbered 14 on the plan. Its interior measurement is 27 ft. by 20 ft.; its walls, standing at present some 2 ft. 6 ins. to 3 ft., are covered with plaster, which in earlier periods of splendour evidently had a very carefully prepared surface, with a graceful and artistic floral design painted in beautiful and varied colours, In course of time this plastering appears to have been injured, and in a subsequent period of less splendour the walls of this room had been re-plastered, the renewed surface being coarse, greyish blue in colour

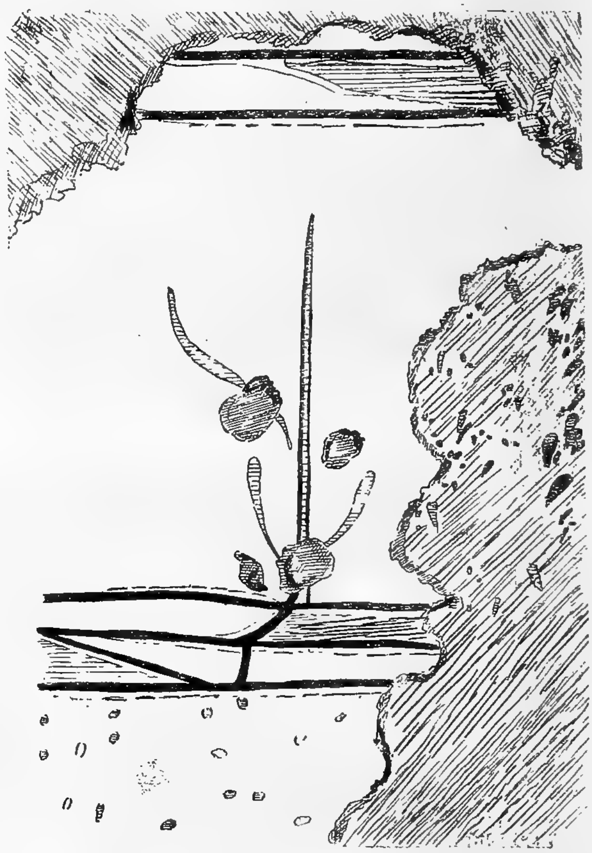


Fig. 6.—Wall Decoration.

with a splash ornament of red and dark blue. In fig. 6 a patch of the more recent plastering, with the splash decoration, is shown to the right and shaded diagonally, whilst the other part represents a place where this coarser plastering has fallen off and exposed the superior and more ornamental but injured under surface. In this the ground is deep ochre yellow, the conventional floral design is red, the central spike having a black outline; the lower bands are respectively orange, yellow, and red, whilst the dividing lines between them are black and white, the lines at the top being also black and white, enclosing an orange and yellow band, separated by a white line. The spots on the dado are red and white, the ground being pink. The irregular patches are injuries which the plaster has sustained. It is noteworthy that the colours are bril-

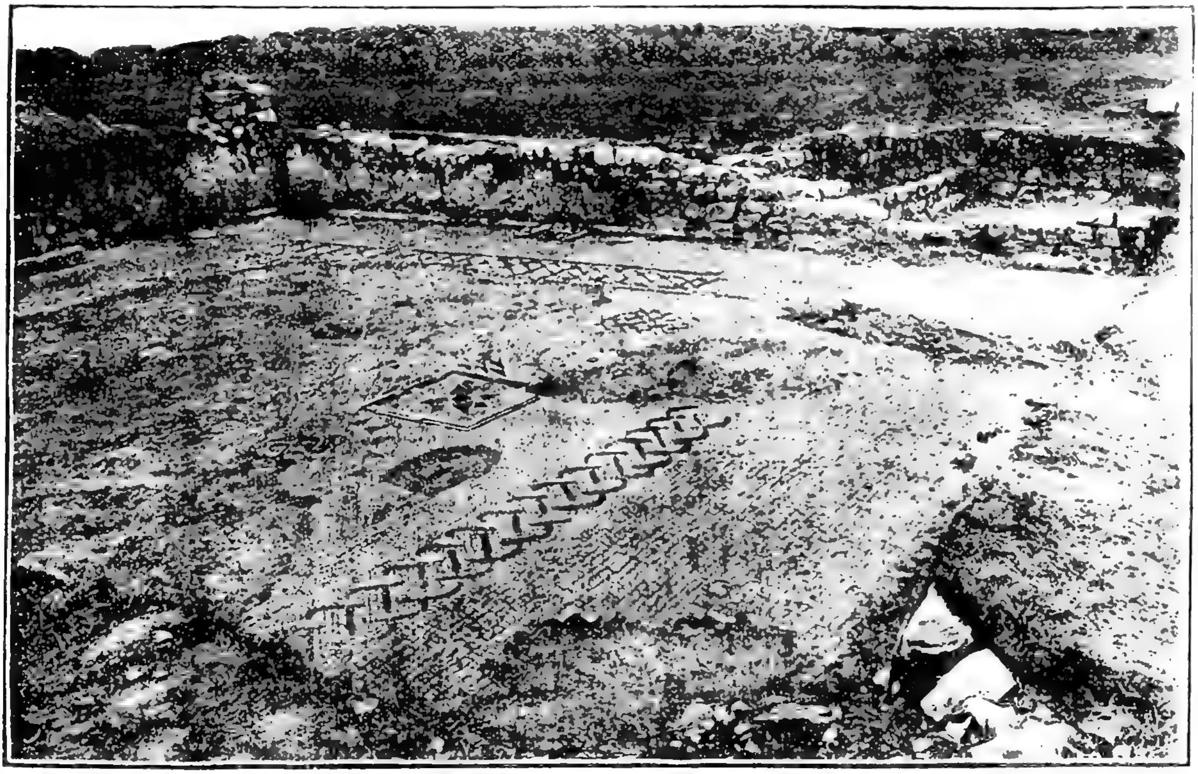


Fig. 7.—General View of Room.

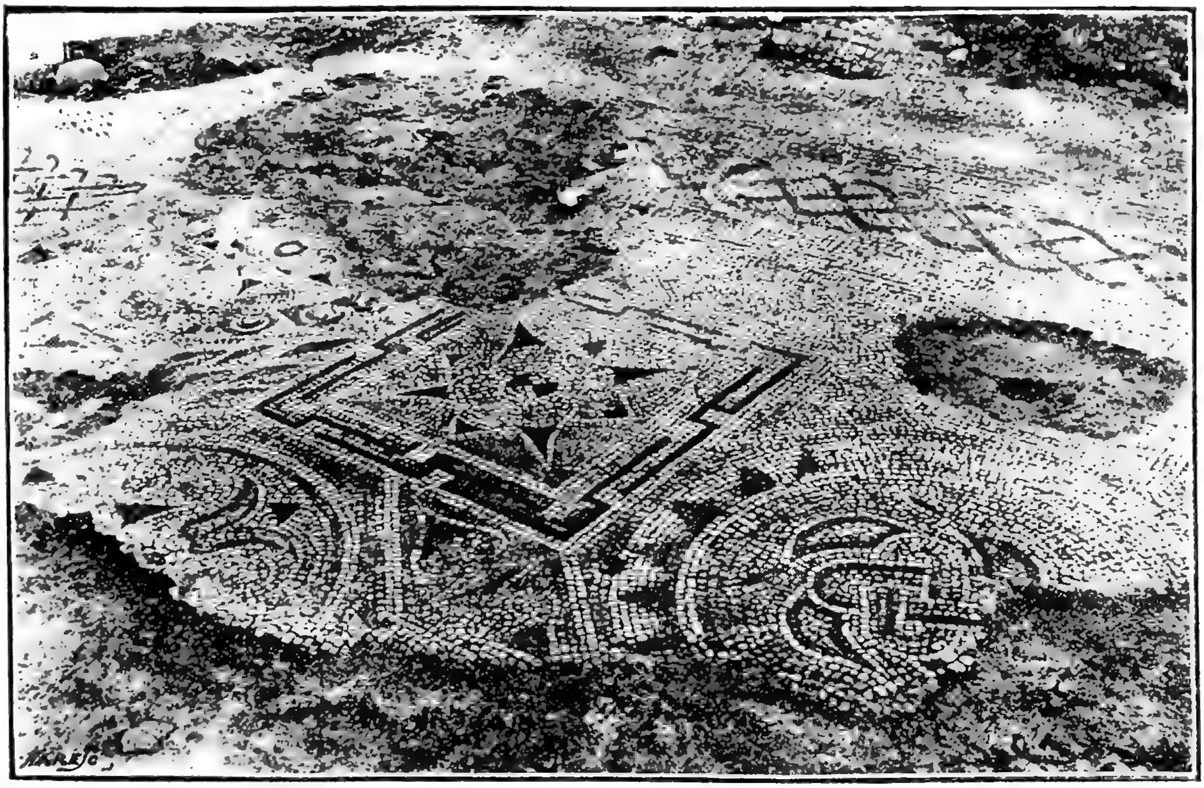


Fig. 8.—Details of Tesselated Pavement.

liant and beautiful at the time of excavation, and from their appearance seem remarkably pure, but unfortunately they very soon fade after exposure. Mr. Thomas has, whenever an opportunity occurred, seized the opportunity of making a permanent register in his own studio of both the colours and designs.

Passing now to the floor, the beautiful and elaborate character of the design of this pavement will best be gathered from the illustrations figs. 7 and 8, which are from a photograph taken by Mr. W. H. Kitchin, of Cardiff. Owing to loss of notes, we are unfortunately not able to set before our readers such a full description as we wished to do. But a little attention will reveal the elaborate and beautiful character of the geometrical designs; for instance, in the portions shown, octagons enclosing circles and a central design will be seen to alternate with square-bordered patterns, whilst no two adjoining circles or squares, as the case may be, contain tessellæ arranged in the same order either as regards shape or colour, whilst the intervening loops or spaces are equally varied in pattern and arrangement of colour. The border which immediately surrounds these figures consists of straight-line designs, triangles, and diamonds, which appear to have been repeated at frequent intervals, whilst this, in its turn, is encompassed first by plain rows of tessellæ, then by the fret border, the space between this and the wall being filled up by plain tessellæ. The colours employed are white, cream, blue-grey, red, and two shades of green. Some indication of the colouring may be gathered from the lights and shades in the illustration. It is on this point that notes are wanting, but it is certain that the effect as a whole showed considerable artistic skill both in arrangement of colour and design; take, for instance, the intervening border of various straight-line designs between those replete with varied and numerous curves. Attention might be called to many instances of well-thought-out contrasts, but space will not permit of more just now It seems probable that the whole series of designs repeated themselves at each corner, and probably there was a very fine centre-piece. Anyway, it will be noticed that the pattern at the north-east corner resembles that at the south-west angle opposite it. There is evidently no doubt that the pavement belongs to the palmy days of the art, and is probably the work of the second century A.D. It is noteworthy that all the tessellæ are nearly or absolutely cubical, and most of them were obtained from the neighbouring rocks, cream-colour and blue from the limestones, red from tiles, green and white are marble, the former stained. The cream-coloured tessellæ prevail.

Midst all this beauty, the excavations revealed an overwhelming quota of horrors, for in this and the adjoining room (17 in the plan) no less than forty-one human skeletons and the remains of at least two horses were unearthed. With the exception of one, all the skulls were found fractured, which seems to indicate that all these people, including men, women, and children, were massacred, receiving a mortal blow on the head. Only three skeletons showed any signs of the corpses having received any attention; one of these, a female figure, had been carefully placed in a rough grave broken in the tesselated pavement, and banked round with stones (15 in the plan and the somewhat obtrusive blemish in our illustration), whilst the other two were buried in the adjoining room in a similar manner (18 in plan). The latter room is about 16 ft. 5 ins. by 22 ft., and was connected with the other by an arched opening; it is also tesselated with cream and grey tessellæ without design; the walls were plastered with coarse plaster with splash decoration. The plastering shows ranging characters in the various chambers encountered along the course of the trench. It seems as if the quality of the plastering would indicate the standing of the room in the estimation of the Roman inhabitants of a habitation. In the present instance we find fine plastering associated with the magnificent pavement, coarser plastering with simpler pavement, and still coarser plastering in some other parts already exposed. Another point about these people, a personal one: it is remarkable in what good preservation all their teeth must have remained during life. It is quite an exception to see them decayed; in fact, it is quite possible to judge the age of these folks by their teeth, the older ones having these useful organs more worn down by the years of grinding or tearing they have performed. The skull of the skeleton of the old woman found on the steps leading to the hypocaust (plan, 12) was also battered about, and when unearthed her head was resting on her hand. The coins discovered are of the reigns of the Emperors Tetricus, Victorinus, and Constantius Chlorus, and give another clue as to the date of the remains, which of course must have been in existence as a habitation during the circulation of the coins of the reigns indicated, and would fix the date of the destruction of the place some time after the reign of the last-named emperor. Several opinions as to the origin, use, name, and collapse of this Roman habitation have been given in the local press and by individuals, and as they may interest our readers, we will give briefly one or two.

The *South Wales Daily News*, when noting the fact of the great number of broken skulls found in the two rooms (14 and 17), remarks, "It is presumed that this place was the scene of a massacre by the Irish in A.D. 446, when they over ran the country during one of their periodical invasions."

The *Weekly Mail* suggests that it may have been the residence of Claudia Ruffina, the daughter of Caractacus, after her return from captivity in Rome. Her Welch name Eurgan is connected historically with the spot; in fact, the latter part of the name Caer-urgan seems to be a corruption of her name. Some say it is the site of the town Bovium; some think it a villa, others a military station.

THE GRINNELL FIRE EXTINGUISHER.

"A STITCH in time saves nine," and the immediate application of water to a fire just beginning will prevent a serious conflagration. With this in view, several systems of spraying or sprinkling of water have been introduced, but none, so far as we are aware, equal in certainty and efficiency that perfected by Mr. Grinnell. As in the case of many inventions connected with the extinguishing of fires, this one also was first brought out in the United States, and the satisfactory results obtained with it there led to its introduction into England and other countries. It is stated that at present there are over 5,000 buildings in various parts of the world which are under the protection of this system; it is added, moreover, that 330 fires have been successfully extinguished by it.

The system adopted is to have lines of horizontal pipes, from eight to ten feet apart under the ceiling of each room, and these pipes are connected with larger vertical pipes which are supplied with water at pressure, from the street main or from an overhead tank. The sprinklers are attached to the horizontal pipes at distances about ten feet apart, so that there is one for every 100 superficial feet of floor area. Thus a building 120 feet fastened at its lower extremity by solder which melts at about 160 degs. F. An elastic seat is at the same time pressed against the valve by the pressure of the water, so that there is no leakage, and the greater the water pressure the tighter is the valve closed. The elastic seat not only serves to close the valve, but when

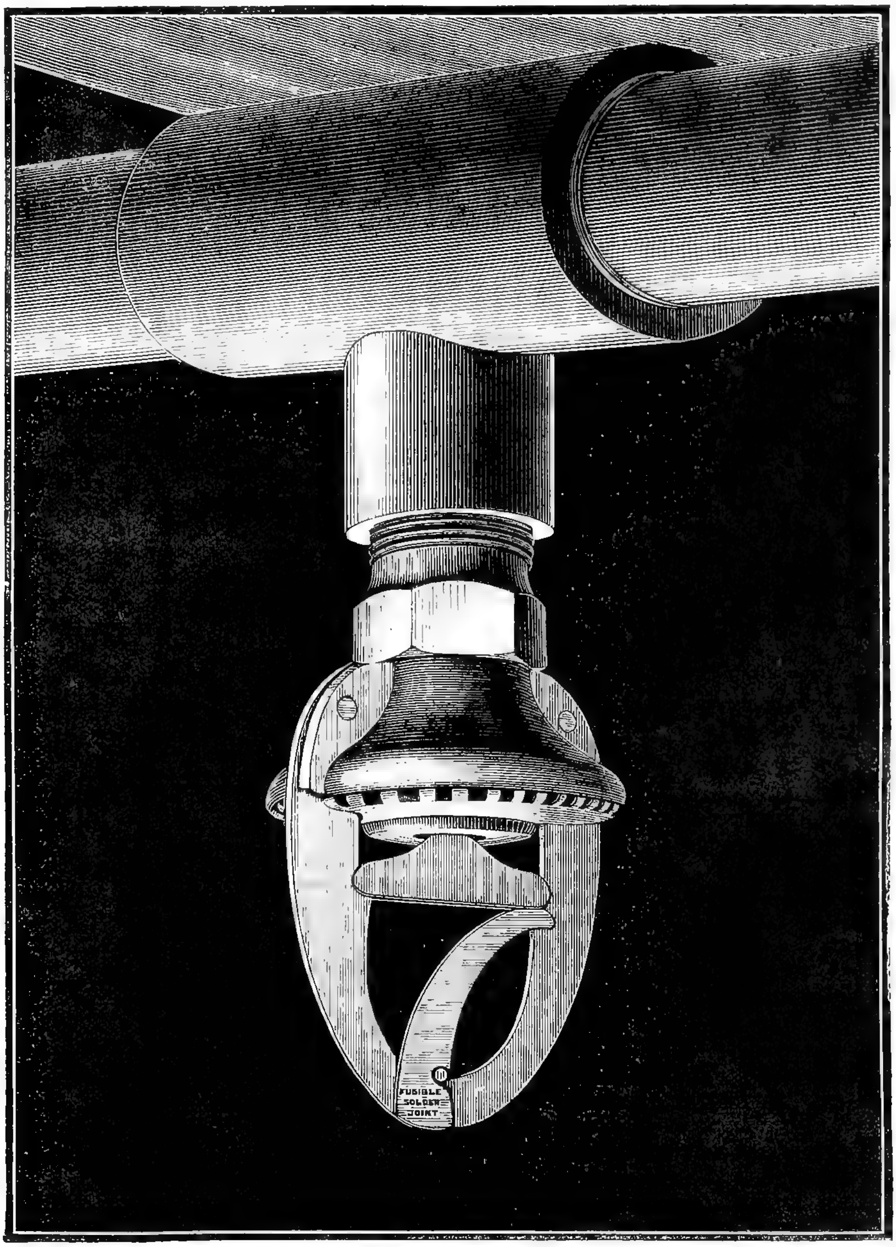


FIG. 1.—GRINNELL'S SPRINKLER IN POSITION.

long by 60 ft. wide, and four floors in height, should have 72 sprinklers in each room, or 288 for all the rooms. The accompanying illustration (fig. 1) represents the sprinkler as seen when not in action, and fig. 2 is a sectional view of a sprinkler discharging water. Its construction is at once simple and ingenious. A well-fitting and specially contrived valve is held in position by the curved lever shown in fig. 1, and this lever is the soldered joint of the lever begins to yield, the seat moves simultaneously with the valve, to the extent of its elasticity, and thus keeps the valve opening covered until the soldered joint is completely severed. This is a detail of much importance, for if a slight escape of water were possible before the soldered joint were quite broken the solder might be cooled and reset, and the action of the sprinkler would be defeated.

From the foregoing it will be readily understood that as soon as the temperature of the room in which the sprinkler is placed is high enough to melt the solder joint, the valve is opened by the pressure of water in the pipe, and the sprinkler is at once in full operation. The sensitiveness of its action has been tried in many ways, and it has been proved beyond doubt.

In buildings which are not artificially heated, and in

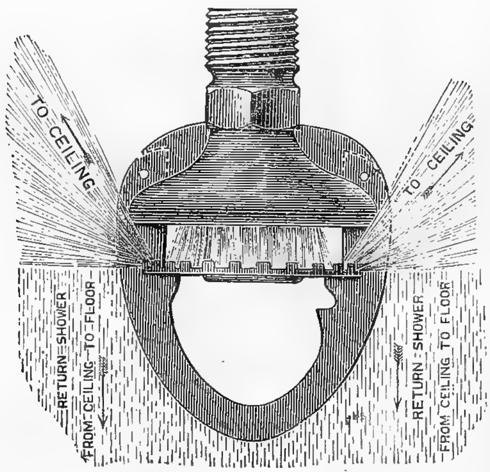


Fig. 2.—Sectional View of Grinnell's Sprinkler in Action.

which the water in the pipes might freeze, the pipes are kept charged with compressed air. In case of fire, when the valves of the sprinklers open, the air instantly escapes, and by an automatic arrangement it is at once followed by water. In places where the town water supply is intermittent, or does not give a pressure of 10 lbs. per square inch, on the top floor, it is usual to provide a tank high enough above the highest sprinkler to give the pressure required. In many country districts there is an overhead tank and an ordinary pump. Last, but not least, is the automatic alarm gong which gives warning immediately there is any escape of water inside the buildings where the sprinklers are. This alarm gong is actuated by the flow of water set up when there is an escape from any cause whatever, and its action continues so long as the escape takes place. This is a most useful adjunct, and is only second in importance to the sprinkler itself. The agents in London for the Grinnell system are Messrs. A. Ransome and Co., Stanley Works, Chelsea.

CABBAGES.

HERE and there along the south coast of England and the Welsh coast we find a plant known as the sea-cabbage (*Brassica oleracea*). It grows in tolerable plenty on the chalk cliffs of Dover, and is also recorded from the Isle of Wight, Cornwall, South Wales, and Great Orme's Head. It is about 20 inches high. The leaves are large and jagged, covered with a blue-green bloom. The stem is tough and woody. The flowers are of a pale yellow colour, and are succeeded by pods. The plant belongs to the order of Cruciferæ, the same large and important order which yields the turnip, radish, mustard and water-cress.

From this wild original (or possibly from it and one or more closely allied forms not easily distinguished) have been derived the countless varieties of the cultivated cabbage. Red cabbages, Brussels sprouts, with their crowds of little leaf-buds, cauliflowers, with their dense masses of imperfect flowers, brocolis, savoys, and kohl-rabi, are all cultivated forms of the weedy ragged sea-cabbage. In Jersey, Mr. Darwin tells us, a cabbage-stalk has grown to the height of 16 feet, and had its spring-shoots at the top occupied by a magpie's nest, while the woody stems are often 10 or 12 feet long, and have been used as rafters and walking-sticks. A cabbage-stalk fashioned into a walking-stick may be seen in the Museum of Economic Botany at Kew. The principal varieties were established before botanical curiosity had been excited, and we can only get chance bits of information as to the time and place of their first appearance. Theophrastus knew of three cabbages, Pliny of six. Regnier has collected evidence that cabbages were cultivated by the Celts of ancient Gaul. There is no hint that cabbages were known to the ancient nations of the East, and De Candolle, who has made laborious researches into the subject, believes that the cultivated cabbage is of European origin.

No more curious instance is on record of the conspicuous changes which may be effected by long-continued cultivation and selection. But the cabbage has a more direct and more human interest than belongs to any mere botanical curiosity. It is a factor of appreciable weight in the early civilisation of Western Europe. We can imagine some old European savage, wandering dinnerless along the sea-shore, until at length he was pressed by hunger to experiment upon unfamiliar plants. That savages do thus gain knowledge at the risk of their own lives we may infer from the well-known fact that they are well acquainted with the properties of the common plants of their own country, and can point out which are poisonous, which useless, which good for food. Our savage sees the tall, weedy sea-cabbage, and finding nothing more tempting, he tries its flavour. There is a slight pungency of taste, which raises misgivings, but no ill-effects follow. Next day the sea-cabbage is again resorted to, and in time becomes a regular article of food. Presently some ingenious fellow—the Watt of his age—saves himself the trouble of a daily journey to the shore by transplanting a few cabbages to a patch of ground near his cave. Years, perhaps centuries, later another great advance is accomplished, and men begin to raise the cabbage from seed. Gardens and fences follow. It is no longer necessary to spend whole days seeking food, and the man's hands are set free to make himself shoes, and a coat, and a house.

We have perhaps given to the cabbage some share of the credit which rightfully belongs to barley or some other nutritious plant, but there is no doubt that the cabbage played a considerable part in the early civilisation of Western Europe. Cultivated plants and domestic animals are the very foundation of primitive society. As the plants grow more juicy, and the animals more docile, man too rises to something higher than he was. He becomes able to lead the life which pleases him, and not that which is imposed by climate and the wild productions of the soil. He learns by slow degrees to shape his own circumtances and habits. But his intellectual gifts and his social aptitudes cannot be developed without certain simple natural resources. Of these the chief are plants worth cultivation and animals worth domestication.

General Notes.

THE PYRENEEAN ASSOCIATION.—According to *La Nature*, an association has been formed under this name for the study of the geology, botany, ornithology, and entomology of the Pyrenees. It includes among its members a number both of Spanish and French naturalists.

THE EXPLOSIONS AT KRAKATOA.—In the report on this outburst issued by the Royal Society it is stated that the noise of the explosions was heard at a distance of 2,000 miles from the volcano in all directions, whilst to the south-west it was heard at Rodriguez very nearly 3,000 miles from Krakatoa.

THE NATURE OF MILK.—M. A. Béchamp, in a memoir read before the French Academy of Sciences, shows that milk is not an emulsion, but that its globules are vesicles formed on the type of the cellule, being provided with coatings which hinder them from being separated from the milk by means of ether.

BRICKS FOR PAVING STREETS.—According to the *Chicago Journal of Commerce*, bricks steeped in bituminous matter are used in many cities in the United States for paving the streets with very good results. In localities where there is a very heavy traffic such pavements are found in good repair after being in use for six years.

ABNORMAL SENSE PERCEPTIONS.—The peculiar association of a colour with a sound, so that a certain sound heard at once vividly arouses the sensation of a given colour, is, according to *Science*, not uncommon. The association of colours with smells is a much rarer phenomenon, and that of colours with tastes rarer still. Dr. Féré gives an account of a woman who, after tasting vinegar, saw everything red for a few minutes, and then everything bright green for more than an hour.

NOVEL PHENOMENA WITH GLOW-LAMPS.—According to the *Electrical World*, glow-lamps in the vicinity of apparatus giving considerable static discharges have a very short life. On holding near a Weston lamp (110 volts) the end of a wire connected with a Holtz machine, if the lamp be burning and the machine is turned rapidly, the filament will break in from one to five minutes. The life of lamps can be prolonged by putting over the bulb a wire netting connected with the earth.

QUACKERY RAMPANT.—Dr. B. F. Davenport, chemist the Massachusetts State Board of Health, has been analysing some fashionable tonics or bitters, and has obtained startling results. Of forty-seven of these concoctions which he has examined, forty-six contain alcohol in proportions varying from 6 to 47·5 per cent., the average being 21·5 (!). This is the more deplorable as several of them are stated by the vendors to be free from alcohol. One tonic, containing 41·6 per cent of alcohol, is, as we learn from *Science*, wickedly recommended to "inebriates struggling to reform."

FETISHISM.—Major A. B. Ellis, in his work on the "Tshi-speaking Peoples of the Gold Coast," takes a new view of fetishism. He does not think it characteristic of primitive peoples, or of races low in the scale of civilization, but believes that it is reached only after considerable progress has been made in religious ideas, when the older form of religion becomes secondary. It owes its existence to the confusion of the material with the immaterial; to the belief in an indwelling God being gradually lost sight of, until the power originally believed to belong to the God is finally attributed to the tangible and inanimate object itself.

RESTRICTIONS ON HYPNOTISM.—We find the following good examples recorded in *Science*: The Belgian Academy of Medicine, after a prolonged discussion, has recommended a law prohibiting public hypnotic performances. Austria, Italy, Denmark, Germany, and most of the Swiss cantons have already adopted similar measures. The public have become strongly impressed with the dangers of an unskilled or evil-minded use of hypnotism, and a healthy sentiment prevails in favour of its restriction to experts. At the last session of the French Association for the Advancement of Science it was voted in the section of Hygiene that all public exhibitions of hypnotism should be legally prohibited in France.

ENCROACHMENTS OF THE SEA IN BRETAGNE.—In a letter read at a recent meeting of the French Academy of Sciences, M. Dechatellier described a submarine peat-digging near Pont l'Abbe. The fact is not novel, and in 1882 Alexandre Chévremont wrote, in his work on the "Movements of the Ground:" "From the mouth of the Loire to that of the Cœsnon, all round the Peninsula, there are found imposing vestiges of forests beyond the present coast lines. M. Dechatellier describes Roman remains 800 metres in advance of the coast, at a point which is now always under water. MM. Gosselet and Rigaux have found on the Flemish shore marine deposits covering remains of the Roman epoch.

THE EARTH'S CLOUD BELTS.—We learn, from the researches of M. Teisserene de Bort, that there is a marked tendency of the earth's cloudiness throughout the year to arrange itself in belts parallel to the equator. A belt of maximum cloudiness may be traced near the equator, two bands of light cloudiness extending from 15 to 35 degrees of latitude north and south, and two zones of greater cloudiness between 45 and 60 degrees, beyond which the sky seems to become clearer towards the poles. These zones have a noticeable tendency to follow the sun in its change of declination, moving northward in spring and southward in autumn. The zones of clear sky correspond with regions of high pressure. The distribution of cloudiness, according to M. De Bort, is a direct consequence of the course of the wind.

VULCANO IN A STATE OF FRESH ERUPTION.—Shortly before November 15th this island showed fresh signs of volcanic activity, and at present its many craters are in a state of eruption more intense than that of last August. Every two minutes ashes and stones are thrown high into the air, each outburst being accompanied by tremendous noises and falls of rock. No one is now on the island, nor does any one approach it, save an old man who goes for a few minutes each day to trim and light the lighthouse lamp. Stones from Vulcano are said to fall frequently at Milazzo, the point of Sicily nearest it, whilst at Messina clouds of volcanic dust, driven thither by the wind, blacken the streets and irritate the eyes of passengers. If these violent outbursts continue, it is said, the whole of the island itself must go to pieces.

Inauguration of the Pasteur Institute.—The magnificient establishment, which is the result of a universal subscription, in honour of the labours of the illustrious savant, was inaugurated on November 14th. The President of the Republic, many eminent strangers, and a great number of notabilities of the official world, of science, and of the Press were present at the ceremony. The Pasteur Institute is situate in a large plot of ground in the Rue Dutot, in the quarter of Vaugirard. The ceremony was held in the large hall of the library, which had been decorated for the occasion, and around which were placed busts of the Emperors of Russia and Brazil, Madame Boucicaut, Madame Furtado-Heine. Discourses were pronounced by MM. Bertrand, Perpetual Secretary of the Academy of Sciences, Christophle, Governor of the Credit Foncier, Dr. Grandcher, and Pasteur. The Institute consists of two large blocks of buildings connected by an intermediate wing.

A New Chromotype Process.—Our attention has recently been drawn to a new patented process for producing letterpress blocks in colours, which is being introduced into this country by Messrs. Hare and Co, of 7, Bride Court, and 31, Essex Street. In this process, owing to the much greater degree of contrast from light to dark which can be obtained, the number of colours required to reproduce any copy is reduced, on the average, from five to eight, whereas in ordinary lithographic work many more would have to be used. Not only is the cost of the blocks less than the cost of the lithographic stones, but there is also a saving in the relative cost of lithographic and letterpress printing. In addition to these advantages, the inks used in the latter method of printing are usually more brilliant than those employed in the former, hence the finished picture is very bright and vigorous. Indeed, the specimens we have seen leave nothing to be desired in this respect. We anticipate this invention will, before long, play an important part in the illustration of scientific and artistic journals.

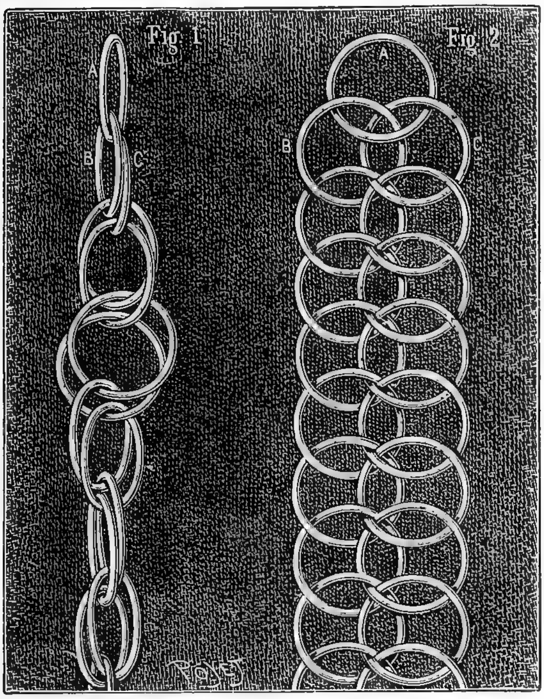
An Extraordinary Phenomenon.—According to a letter in the *Times*, on the night of Saturday, November 3rd, at a time as near 8 o'clock as possible, the tens of thousands of sheep folded in the large sheep-breeding districts north, east, and west of Reading were taken with a sudden fright, jumping their hurdles, escaping from the fields, and running hither and thither; in fact, there must for some time have been a perfect stampede. Early on Sunday morning the shepherds found the animals under hedges and in the roads, panting and frightened as if they had been terror-stricken. The extent of this remarkable occurrence may be judged when we mention that every large farmer from Wallingford on the one hand to Twyford on the other seems to have had his sheep thus frightened, and it is also noteworthy that with only two or three exceptions the hill-country north of the Thames seems to have been principally affected. The writers, Messrs. Oakshott and Millard, suggest that a slight earthquake was the possible cause of the panic. The matter had already come under the notice of Mr. G. J. Symons, F.R.S., of 62, Camden Square, N.W., who will be glad to receive and consider any information bearing upon the subject.

Interesting Discovery at Sherborne Abbey.—On Saturday week, while the workmen at Sherborne Abbey were engaged in excavating along the main aisle, they came across a heavy lead coffin resting in its vault, and which, unless removed, would have been in close proximity to the heating apparatus. The medical officer of health was consulted as to whether there was any danger of gases emanating from it if it were left where it was. On being opened, the coffin was found to contain the body of a young lady, apparently about twenty years of age, and evidently a person of high social rank. The body was wrapped in a coarse kind of flannel, the head being enveloped in a frilled head-dress of the same material. On removing a portion of the flannel placed over the face, the features of an exceedingly good-looking person were found to be perfect. The front teeth, slightly showing themselves, were found to be perfect and regular, but almost black. The churchwardens decided to have it carefully removed and buried in the cemetery. The coffin lay in a brick vault at the west end of the main aisle, and had been buried in the orthodox fashion, with the feet towards the east. There was no plate, and the probability is that it had been stolen during the early history of the church, or had somehow disappeared. The outer oak encasing the lead had entirely rotted away, leaving a dark powdery substance lying on the lead about two inches in depth. The body was lying in a shell of oak, which had also nearly decayed. Having regard to the oxidised appearance of the lead, which was of great thickness, and the general appearance of the remains, the opinion is that they must have lain where they have been for seven or eight hundred years at least.

The Public Health.—The Registrar-General's return for the week ending November 17th, shows that the deaths registered during that period in 28 great towns of England and Wales corresponded to an annual rate of 19·7 per 1,000 of their aggregate population, which is estimated at 9,398,273 persons in the middle of this year. The six healthiest places were Brighton, Bristol, Leicester, Derby, Nottingham, and Birmingham. In London 2,606 births and 1,619 deaths were registered. Allowance made for increase of population, the births were 188, and the deaths 75, below the average numbers in the corresponding weeks of the last ten years. The annual death-rate per 1,000 from all causes, which had been 21·2, 19·7, and 18·5 in the three preceding weeks, rose again last week to 19·7. During the first seven weeks of the current quarter the death-rate averaged 19·2 per 1,000, and was 0·5 below the mean rate in the corresponding periods of the ten years 1878-87. The 1,619 deaths included 124 from measles, 31 from scarlet fever, 44 from diphtheria, 17 from whooping-cough, 15 from enteric fever, 16 from diarrhœa and dysentery, and not one from small-pox, typhus, ill-defined forms of fever, or cholera; thus, 247 deaths were referred to these diseases, being 30 above the corrected average weekly number. In Greater London 3,394 births and 2,028 deaths were registered, corresponding to annual rates of 32·0 and 19·1 per 1,000 of the estimated population. In the Outer Ring 12 deaths from measles, seven from diphtheria, five from "fever," and four from scarlet fever were registered. Three fatal cases of scarlet fever and three of measles occurred in West Ham sub-district, and two of measles and two of diphtheria in Enfield sub-district.

THE MAGIC CHAIN.

A CURIOUS little thing is to be seen occasionally offered for sale in the streets, and as it is easy to make, and is the subject of a very remarkable optical illusion, it may interest our readers. It consists of two chains, the links of which are crossed, as shown in fig. 1. By holding in one hand the highest ring A, and raising the ring B with the other, if the ring A be dropped it will appear to fall through the ring C, and so through the remaining rings, until it reaches the bottom of the chain. The fall of the ring is really an impossibility, and is only



THE MAGIC CHAIN.

an optical illusion. In raising the right chain the rings are in some measure turned, and the movement is transmitted from one ring to the other, so that the first one seems to fall from the top to the bottom of the chain, when, in reality, each ring drops successively. The movements, however, are so rapid that the eye cannot follow them, and receives the impression that the same ring is descending throughout the chain. Fig. 2 is the plan of the two chains of which we have only shown one end. The chain, however, can be made of any length.

THE VENOM OF SERPENTS; ITS NATURE AND ITS ACTION.

M. LAVERUNE has communicated to *Cosmos* an article on the venom of serpents, which calls for certain remarks. He states that "no serpent is large enough to devour a man, and that if serpents occasion so many deaths they are impelled neither by hunger nor by malice. They bite when they are surprised."

Now, leaving all doubtful stories out of the question, pythons and boas exceeding 30 ft. have certainly been captured; and if we consider their enormous muscular power, we can scarcely doubt their ability to destroy a man. Waterton, in his "Essays," tells us that when in Angustura a Spaniard showed him part of a serpent's skin, "which, judging from its amazing thickness, could not have been less than 70 ft. in length. The colonists have appropriately given to this serpent the name of *matatoro*, or bull-killer." Making all due allowance for the fact that Waterton did not actually measure, but merely estimated the size of this serpent, such a record, given by an experienced out-door naturalist, makes us doubt whether there may not exist larger specimens of serpents than have as yet been exhibited in our museums.

Nor can we say that the venomous species never act on the offensive. More than 20,000 persons perish annually in India from the bite of the cobra and of the kerait (*Bungarus cœruleus*).

Even in Europe the deaths from snake-bites are not trifling in number. Within six years M. Viand-Grand-Marais collected in the French departments La Loire and La Vendée 321 cases of the bites of vipers, of which sixty-two, or in round numbers one in five, proved fatal. With this proportion our own estimates, based on observations in the south-east of Europe, will fairly agree. At the same time we must bear in mind that the stings and bites of all the less venomous animals are very much affected in their activity by the constitutional state of the sufferer. In this season two cases have been recorded in each of which a man died from the sting of a single wasp.

The bite of the cobra is, however, hopelessly fatal even to the most healthy and vigorous man, unless the wound can be immediately cut out. The asp by means of which Cleopatra put an end to her life was a closely allied species, *Naja haje*. At the time when Galen was studying in the school of Alexandria this serpent was used as the public executioner. The condemned criminal was bitten by an asp. This method was more certain, though less rapid, than the electric discharge now introduced in New York.

The poison of serpents has been the subject of numerous investigatious, both biological and chemical. Inquirers have not been content to observe the effects of accidental bites, but ingenious experimentalists have collected the liquid from the fangs, and have sought to examine the mechanism of its action. In order to collect the poison certain physiologists have proposed to dose the serpent with chloroform and to extract the contents of the venom gland by pressure. This method is scarcely practical, as many of the serpents succumb to the effects of the anæsthetic vapour. The easiest method is that of Sen. De Lacerda. He coils cotton around a stiff rod, and incites the serpent to bite it between the grating of its cage. The cotton becomes charged with the venomous liquid, which can then be obtained by pressure. It is diluted with a little distilled water, and serves for experimental inoculations. If it is not wanted for immediate use it is preferable to keep the saturated cotton and to let it dry. If moistened with a few drops of water a long time after, it resumes all its virtues—or vices. Such a shred of cotton may thus be preserved in a ring, and may serve as the instrument of a "rapid and elegant" suicide. We query both the rapidity and the elegance. The soluble cyanides are far more rapid, and as for the "elegance" of this method of death, our readers may judge from the description of the symptoms which follow the bite of a death-snake. The method which M. Leverune describes

—we will not say recommends—is to bite the lip, and apply this murderous shred of cotton to the wound.

The venom, thus collected, is an article of commerce, and is used, we believe, successfully in treating the malignant fevers of tropical climates. Like many other products, it is not only sophisticated, but even counterfeited altogether. An eminent firm is said to have sold to a distinguished chemist, at a very high price, a quantity of alleged cobra venom which on examination proved to be merely distilled water mixed with a little gum.

"To whatever species it belongs," says M. Leverune, "the poison possesses approximately the same properties." This assertion we cannot accept without further evidence, since the effects of the bite of different serpents seem to vary, not merely in intensity, but in quality. It is a ropy liquid of a yellowish colour. If examined with the microscope it is found to contain numerous organised particles, micrococci or microzymas. But these microbian elements are not the active principle of the venom. If heated to 230 degs.—257 degs. F.—it retains all its virtues. If inoculated it does not reproduce itself, and it cannot be cultivated. It is, therefore, not a *virus* like the poisons of zymotic diseases.

Prince Lucien Bonaparte isolated from the venom of the viper a proximate principle which he called *viperine*. Mitchell has discovered the same principle in the venom of the rattle-snake, and has named it crotaline. Crotaline and viperine produce the same effects as the liquids from which they were extracted. If mixed with alcohol, ammonia, potassa, tannin, or iodine, they retain all their activity.

Iodine certainly diminishes the local affections, but the general effects remain the same. This explains the inefficacy of counter-poisons.

It must here be remarked that chloride of platinum if added to the venom of the cobra in a concentrated state destroys its virulence. But if the poison be introduced into the blood, and the remedy be then applied, it is useless, because it is too much diluted by the blood to exert its efficacy. Moreover, it is unable to *overtake* the poison if the latter has the start. The fact that serpent-poisons are not ferments, like disease-germs, explains that germicides, such as phenol, salicylic acid, etc., are useless.

Dr. Winter Blythe discovered in the poison of the cobra a principle to which he gave the name *cobric* acid. But the deadly secretion is now admitted to be very complex.

Armand Gautier considers the action of snake-venoms similar to that of the ptomaines, or putrefactive alkaloids, whose effects are analogous. It is known that under certain conditions the albumenoid molecule is split up with a production of alkaloids, for the most part poisonous. These alkaloids, produced in dead bodies, are known as ptomaines. But the living body produces similar bodies, the leukomaines, the residues of nutrition, which are eliminated by different channels. The production of poison is one of the general functions of the living cell, even when its life is not modified by extra-physiological or morbid causes.

In serpents this function is especially committed to certain cells, and thus contributes to secure the life of the species.

The venom of serpents is in some degree analogous to the saliva and the pancreatic secretion. But these analogies are superficial. Sen. De Lacerda even thinks that it assists in digestion. He injected the pancreatic liquid of venomous serpents into the saphene vein of dogs, which quickly fell victims. This experiment is not conclusive. It results from the researches of Béchamp that the microzymas of the pancreas of various animals are fatal if injected into the veins. The digestive action of the venom has no cause for existence, since the salivary glands and the pancreas exist in all serpents, whether venomous or not, and suffice for this function.

Viaud-Grand-Marais has carefully described the symptoms of snake-poisoning. He divides them into primary, secondary, and tertiary.

The primary results are pain—often very acute—and swelling. The part wounded becomes livid and grows cold. Then, if the case be severe, the swelling extends along the limb; then occurs an indescribable state of depression, accompanied with vomiting. The pulse and the respiration become slow, the extremities grow cold, the body is covered with a cold sweat, and the patient dies more or less rapidly after several fainting-fits. These states may follow each other very rapidly; the primary and secondary symptoms are blended together, and in a few hours all is over.

In other cases pulmonary congestion and paralysis succeed, and may last for months. Sometimes there remain very durable traces of the poisoning. This is what Viaud-Grand-Marais calls the tertiary effects. There is sometimes a periodical return of pain and swelling on the anniversary of the day when the wound was received.

Concerning the remedial treatment little can be said, as in case of the more deadly species instant amputation of the part bitten is the only safeguard. Partial success has been attained by keeping up artificial respiration. Some cases of the bite of the rattlesnake and of the puff-adder are said to have been cured by administering large doses of alcohol and keeping the patient constantly in motion. Ammonia injected and applied to the wound is said to have proved successful in Australia. The injection of permanganate of potash is recommended by Lacerda, in accordance with experiments performed in Brazil (with the labarra?) and in Africa with the horned viper (*cerastes*). But there is no instance on record of its proving of any value in case of the bite of a cobra, a hamadryad, or a kerait. Couty has thrown considerable doubt on the experiments of Lacerda. The natives of countries inhabited by death-snakes do not seem to have any remedies upon which they rely. If bitten they generally lie down and await their end in fatalistic apathy.

In certain parts of Southern France the country people treat the bite of a viper by rubbing the wound with any three herbs, no matter what, if only they are of different species!

The question may be asked, How, on the principle of natural selection, have certain serpents been able to develop a power of poisoning so far in excess of their needs? The bite of the cobra is fatal to a man, but the serpent cannot swallow its victim. Moreover, the person bitten has ample time to kill his assailant, so that the poison is of little service as a defensive weapon.

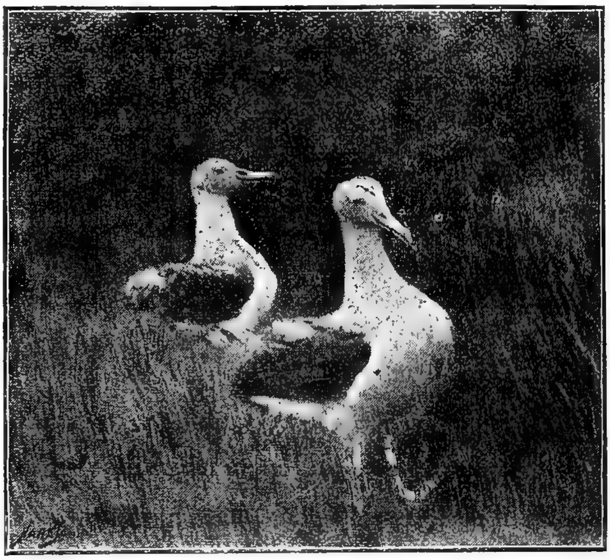
THE IDENTITY OF THE NATIVE AMERICAN AND MONGOLIAN RACES.—Dr. H. Ten Kate (*Science*) writes in reply to Dr. D. G. Brinton, who recently denied the Mongolian affinities of the American race.

Natural History.

THE ALBATROSS.

THE albatross (*Diomedea*), the largest and strongest of the petrel group, belongs to the family of *Longipennatæ*, or long-winged birds; order, *Natatores*. Its name *Diomedea*, assigned to it by Linnæus, is said to bear reference to the mythical metamorphosis of the companions of the old Greek warrior Diomedes into birds. Its popular name of albatross is a corruption of the Portuguese "alcatraz," a word applied by the early navigators of that nation to cormorants and large sea birds generally. The albatross is an inhabitant of high southern latitudes, but it frequently visits Behring's Straits and the vicinity of Kamtschatka, particularly the Kurile Isles, the Bay of Pentschinensi, and the Inner Sea, attracted thither by large shoals of migratory fish. Its chief home, however, is in the Southern Seas, and it breeds principally on the lofty cliffs of Tristan d'Acunha, in the South Atlantic Ocean, the Crozette Islands, Marion Islands, etc., flocking in great numbers round the Cape of Good Hope, where the sailors know them under the name of "Cape sheep." During the breeding season, which in the Southern hemisphere is about September, these birds assemble in considerable numbers in their favourite haunts, which then present a rather impressive appearance to the chance human observer. Mr. Earl gives the following description of a visit to one of these homes of the albatross:—"A death-like stillness prevailed in these high regions, and to my ear our voices had a strange unnatural echo, and I fancied our forms appeared gigantic, while the air was piercingly cold. The prospect was altogether sublime, and filled the mind with awe. The huge albatrosses here appeared to dread no interloper or enemy, for their young were on the ground completely uncovered, and the old ones were stalking calmly round them. They lay but one egg on the ground, where they make a kind of nest by scraping the earth round it. The young is entirely white, and is covered with a woolly down, which is very beautiful. As we approached they snapped their beaks with very quick motion, making a great noise. . . . I again visited the mountain about five months afterwards, when I found the young albatrosses still sitting in their nests as if they had never moved away from them." The rough nests of which Mr. Earl speaks are probably those of the wandering albatross (*Diomedea esculans*). The sooty albatross (*D. fulginosa*) bestows rather more care upon the construction of its nest, which is formed of a pile of mud some five or six inches high, with a depression on the top, while that of the yellow-beaked albatross (*D. chlororhynchus*) is, comparatively speaking, quite an elaborate affair, the mud at least a foot high, smoothly rounded, with a well-defined hollow at the top, and a little trench all round the base. All these species seem equally indifferent to the presence of human beings in their homes, and manifest but little irritation even when kicked aside or knocked off their nests, although occasionally one of less placid temperament than the rest may retaliate by squirting oil out of its beak on to the clothes of the intruder. The parent birds seem to have a large supply of this oil, and are said to sometimes feed their young with it. The eggs are about four inches long, and according to Sir James Clark Ross are esteemed great delicacies by the seal hunters in the Southern seas, who also pronounce the young birds delicious, which latter, however, would seem to be somewhat of an Esquimaux taste. The flesh of the older birds is distinctly unpalatable; it can only be rendered eatable by being laid in salt for a long time, and then boiling it with some piquant flavouring.

The plumage of the albatross is usually all white, save the wing-feathers, and some transverse bands across the back; its flesh-coloured feet are short and webbed; its yellow beak very strong and hard, as long as the whole head, and straight, save at the extremity, where it suddenly curves. The upper mandible is deeply furrowed, and the nostrils are placed laterally in the roll of the furrows. On examination of the skull of an albatross, a deep cavity is found just above the eyes, which during life contains a gland, whose use and purposes are still somewhat dubious. Dr. Bennet, after carefully dissecting several of these glands, announced that they were "formed of a hard granular substance of a pale colour, consisting of numerous distinct oval bodies, and on being cut are found abundantly nourished with blood vessels. The nerves supplying them come from the minute foramina seen on the floor of the cavity, and are distributed in and about the substance of the gland." The body of this bird is bulky, and averages about four feet in length, the total weight of the bird varying from twelve or fifteen, to sometimes as much as twenty-eight pounds. The chief feature of the albatross, however, lies in the immense spread of its narrow powerful wings. Foster estimates this alar extent at ten feet, Captain Cook thought eleven feet a fair average, Parker measured an albatross eleven feet seven inches across, while a specimen in the Leverian Museum measured thirteen feet. The list is crowned by the bird mentioned by both Ives and Parker Gillmore, which was shot off the Cape of Good Hope, and which measured no less than seventeen feet from the tip of one wing to the tip of the other. These great wings have about forty secondary quills, and the bones are perfectly hollow, and as the whole surface of the body is covered with innumerable air-cells, capable of volun-



ALBATROSS.
(From an instantaneous photograph taken by Mr. McDougall, of Invercargill, N.Z.)

tary inflation and diminution, the bird is thus rendered capable of a sustained and buoyant flight unequalled by that of any other living bird. The albatross is widely renowned for the grace and elegance of its flight, affording, as it sails majestically along, with wings outspread and motionless, and with its graceful head bending slightly from side to side to steer its course, a striking illustration of the "beauty of strength." It possesses an unrivalled power of "sailing" for a considerable time with no impetus but its own momentum. The stormy petrel, strong in the wing though it be, never sails at all, and even the night-hawk and other strong-winged birds can only do so for some five or ten minutes, but the albatross can sail without a single movement of its wings for upwards of an hour. Captain Hutton suggests in explanation that its shape, especially when the neck is stretched out, bears a close resemblance to Newton's "solid of least resistance," and that it steers itself carefully to avoid meeting any resistance from contrary currents; but the fact that the albatross can sail against the wind as well as before it, renders the latter theory somewhat unsound. These birds frequently follow passing vessels for the sake of any chance food that may be thrown overboard, or, as Figuier believes, because the agitation of the ship's track brings to the surface various forms of marine life which form the bird's favourite food. Be that as it may, navigators in the Antarctic Seas, where the nights are never dark enough to interrupt observations, assert that the same flock of albatrosses will sometimes accompany a ship for many successive days, without exhibiting the slightest sign of fatigue and without any perceptible relaxation in the strength and evenness of their flight. It was once an article of faith among sailors that the albatross always slept on the wing, poised, like Mahomet's coffin, midway 'twixt heaven and earth, a fanciful conceit which the poet Moore refers to in his "Fire Worshippers,"—

"The ruined tower tower'd so high
That oft the sleeping albatross
Struck the wild ruins with her wing,
And from her cloud-rock'd slumbering
Started—to find man's dwelling there,
In her own silent fields of air."

As a matter of fact, we believe that the monarch of sea-birds, when far out at sea, seeks his well-earned repose on the surface of the ocean, riding on the crest of the waves with his head under his wing, and often so oblivious of the watery world around him, that sailors sometimes stealthily approach a sleeping albatross armed with boat-hooks or harpoons, and succeed in capturing the unwary bird. Fishing for albatrosses—strange though old Isaak Walton might have thought it, to hear of angling for winged and feathered prey—is an amusement often resorted to to enliven the dull monotony of life in those unexciting seas. The albatross must plead guilty to the charge of unbridled gluttony and voracity, and its indulgence of its undiscriminating appetite often ensnares it to its destruction. Small shell-fish and fish spawn are supposed to be the staple article of its diet, but large fish and animal refuse of all kinds are greedily snapped up, and, justly or injustly, it is even accused of assisting at the happy despatch of one of its dead brethren, with no apparent qualms of conscience at its cannibalistic conduct. Thus it may easily be imagined that fishing for albatrosses makes far less demand upon one's patience and perseverance than any other branch of piscatorial sport, for the line being well baited with a good-sized lump of blubber, down swoops the hungry bird, and the bait instantly disappears. It is one thing, however, to induce an albatross to swallow the bait, and quite another to "land" him safely. Sometimes he takes to flight and soars aloft, when he has to be pulled in in kite-like fashion that calls forth no mean amount of muscular force in the fishermen's arms, whilst at others he remains on the water, squaring his wings, and often breaking the line with his fierce struggle. No amount of experience, however, ever seems to instil the slightest caution into an albatross; its size seems fairly balanced by its stupidity, and an albatross but just escaped from the line will sail down again upon another piece of blubber without a trace of hesitation. Indeed, birds who have been actually captured and liberated again with ribbon round their necks to identify them, have sometimes been recaptured more than once by the very same crew. The morals of the albatross are unfortunately not on a par with its noble appearance. It is, as we have seen, both stupid and gluttonous, and in spite of its size and strength, it is cowardly to a degree. When beset by gulls or other small enemies, who invariably attack it under the body, its most vulnerable part, it never fairly shows fight, but either resorts to the simple expedient of diving under water and thus ridding itself of its assailants, or betakes itself forthwith to ignoble flight. Despite these unheroic qualities, however, the albatross was in olden time an object of almost supernatural veneration to the early explorers of the Southern Seas, where it was often the only living thing to cheer their dreary solitude, and all lovers of Samuel Coleridge will remember the weird description given to the spell-bound wedding guest of the suffering and illhap of the man who

". . . with cruel blow did lay full low
The harmless albatross,"

the bird so loved by—

"The Spirit who bideth by himself
In the land of mist and snow."

In this prosaic nineteenth century, however, the albatross is no longer jealously guarded from harm as a bird of good omen, whose death will be followed by mystic and untold woe, but is heedlessly shot and slain as opportunity offers; by sailors, chiefly for the sake of its wings, which make imposing *souvenirs de voyage* for stay-at-home relatives, and by the natives of Kamtschatka for the sake of its intestines and its hollow wing-bones, the latter serving for pipe stems, and the former, well inflated, making excellent buoys for the rough Kamtschatkan fishing-nets.

British Wild White Cattle.—According to the report of the British Association for the Advancement of Science recently issued, it would appear that there are only three herds of the ancient British wild cattle now existing, which were originally enclosed on their own ground. These herds are: 1, Chartley Park, in Staffordshire, belonging to the Earl of Ferrers; 2, Chillingham, in Northumberland, belonging to the Earl of Tankerville; and 3, Cadzow, in Lanarkshire, owned by the Duke of Hamilton. The Staffordshire herd is larger now than it has been for some years past. It contains nine bulls, twenty cows, and five bullocks, making a total of thirty-four head. Chartley Park is a wild tract of some 1,000 acres in extent, and remains in its original condition. Many naturalists from all parts of England come to visit these remnants of the past. An interesting suggestion is made by the Sectional Committee of the

British Association to the effect that if examples of each of the three remaining herds were brought together and allowed to interbreed, they would more nearly revert to the aboriginal wild type, and we should have a better idea of what they were formerly. It is supposed that the fact of the several herds being confined to such a limited area as they now occupy, has caused them to become degenerated and somewhat smaller in size. The experiment, anyhow, is worthy of a trial.

Breeding Canary Birds.—This pursuit has become a business of some importance at Paris, and is conducted under the auspices of the *Société Serinophile.* On November 4th this society held its yearly exhibition of Dutch canaries. The competition took place in the Vautier Rooms, Avenue de Clichy. One hundred and fifteen Dutch canaries were exhibited in their cages, arranged on tables covered with green cloth, and forty-four have received prizes. These birds are worth from 3 to 500 francs each, and the members of the society rear more than 4,000 canaries annually. At Puteaux there are no fewer than 150 cultivators of chickweed for the use of these birds, and it is estimated that more than 10,000 francs' worth of this plant is sold daily in Paris.

The Plague of Mosquitoes at Bombay.—A correspondent of the *Medical Press* ascribes this plague with much probability to the existence of offensive swamps very near to the city. One of these is a stagnant lake of sewage "backed up by heaps of town-sweepings." It is expected that mosquitoes will not be the only result of this shameful neglect. The Bombay Natural History Society applied for the use of the waste and marshy ground at the foot of the Chompathy, intending to drain and reclaim it and convert it into a zoological garden, but their request was refused.

The Solom and its Products.—The attacks of the phylloxera upon the vine have not merely affected the supplies of grapes, of wine, and of raisins, but they threaten a scarcity of two products of great importance in the arts, tartaric acid and cream of tartar, the commercial supplies of which are entirely drawn from the grape. It is therefore very satisfactory to find that the solom (*Dialium nitidum*), an African tree, contains in its fruits both free tartaric acid and cream of tartar (potassium bitartrate), unmixed with any other acid.

The Star-fish and its Depredations —On the coasts of New England the star-fish are estimated to destroy several hundred thousand dollars' worth of oysters every year. These pests cannot live in fresh or brackish waters, and hence they do not infest the oyster-beds of Chesapeake Bay. In a great flood which took place in Rhode Island in the spring of 1886 an immense volume of water found its way into Narragansett Bay, and freshened the water to such an extent that all the star-fishes perished.

The United States Fishery Commission.—According to *Science,* the problem of restocking the coast of New England with in shore cod has been definitely solved. It is only a question of time before cod-fish can be made more plentiful on the New England coast than they were years ago, and a lost industry restored that will be worth millions of dollars to that section of the country.

THE BANDAI-SAN ERUPTION.

A CORRESPONDENT of the *Times* gives the following account of the results of the investigations made, by Professor Sekiya, a young seismologist already known to the world, and Mr. Y. Kikuchi, a geologist—both of the Imperial University—into this eruption, which formed the subject of a paper read by the former before the Seismological Society of Japan on October 11th :—

Sho-Bandai-san, the peak that was destroyed on the 15th July, is, or was, one of a group of four conical mountains, known collectively as Bandai-san, forming the walls of an old elevated crater basin, and rising to a height of some 6,000 ft. above the sea. Stratified volcanic rocks, of the most part gneiss and andesite, form the bulk of this mountain mass, and are mainly disposed in six great layers, the fruits of as many successive eruptions. Lava, apparently of prehistoric date, is found on the slopes. But, though Japanese records often speak of fire and smoke and poisonous vapours issuing from Bandai-san, the latest known active eruption took place 1,081 years ago, and all that remained to warrant the mountain's retention in the list of live volcanoes were a few *solfatara* in and near the old crater, Numanotaira, which from time immemorial have given off steam. On the morning of the 15th of July, however, this condition of tranquility was suddenly and violently disturbed. Soon after the mild preliminary earthquake, which took place at about half-past seven, there came a second and prolonged shock of fearful intensity. Then, while the ground in the whole region was still heaving and groaning and making the houses rock, a dense black column was shot forth from Sho-Bandai-san to a height of some 4,000 ft. During the next minute there were fifteen or twenty repetitions of this phenomenon, all of them accompanied by horrible and tremendous noises. In the last of them, the *ejectamenta* took a course highly inclined to the vertical. Zigzag flashes of lightning, resulting from the electricity generated by the steam explosions, were seen to shoot forth from the ascending columns. Then, for another half-hour, the thunders of minor explosions were heard at frequent intervals. Meanwhile, the lighter particles of the black columns, consisting of mingled steam and dust, rose steadily upward, attaining an altitude of some 12,000 or 15,000 feet above the volcano, and spreading out into a vast cloud like an open umbrella in shape, which shrouded the earth beneath it in midnight darkness, until dispersed and wafted away by the north-westerly wind. From this cloud descended the shower of blue-gray ash, so-called, which has been mentioned in every account of the catastrophe—in reality, volcanic dust or powder (augite-andesite), caused by the violent mechanical disintegration of ejected rocks, hurled swiftly through the air after having been rendered brittle and soft by the action of steam and gases. Highly heated itself, and mingling with the condensing steam, it assumed a fine granular shape and fell on the adjacent country in a solid, scalding rain, which caused shocking injuries to many individuals and clothed the ground with a hot mantle on which it was difficult and painful to walk. On the map this dust-strewn region has the shape of a half-open fan, and covers 1,040 square miles of land area, attaining at the Pacific shore, 62 miles from the volcano, a breadth of some 41 miles, and spreading yet farther over the ocean. About six inches deep at and near its origin, the layer gradually diminished in thickness, till at the coast it was a barely perceptible film. The noises of the explosions were heard some thirty miles to windward of Bandai-san, and 62 miles to leeward. But the earthquake which preceded and attended the outburst, though so prolonged and terrible in intensity, was, strange to say, not felt beyond a radius of thirty miles from the volcano—a fact accounted for by Messrs. Sekiya and Kikuchi on the ground that the seat of violent action was, doubtless, but a little way below the earth's surface, if, indeed, not above the mean periphery and in the bowels of the mountain itself. Steam—a well-known and powerful cause of seismic phenomena—was, as has been already indicated, the agent of the explosions. The great volumes of steam that must be generated whenever, from any cause, subterranean waters are brought into contact with the molten interior, expand and fill up the rock-fissures. If not deep enough down, or if lacking sufficient pressure and volume to break through the superincumbent masses, such ebullitions, though they may wrench and strain and tear the earth's crust internally, are yet hopelessly imprisoned, and can only produce on the surface the phenomena of earthquakes or minor seismic vibrations. But there are cases — happily none too common in this our day—when the pent-up vapour succeeds in bursting open its prison roof along some line of least resistance and working havoc on a prodigious scale. Of such was the explosion which lately rent Sho-Bandai-san in twain.

Besides the lighter erupted matter, whose nature and behaviour have been sketched above, there was the solid body of the peak itself, which, tossed in gigantic masses high into the air, fell upon the slopes and glens, and, rushing down them with fearful velocity until brought to rest on level or nearly level ground or by impassable obstacles, buried twenty-seven square miles of country fathoms deep in *debris*, in the short space of about ten minutes from the first explosion. One of the toughest of the many problems which beset the Japanese investigators was that of accounting for the wonderful and apparently eccentric fashion in which this mighty volume of matter had been propagated and disposed. Persevering examinations, however, soon brought them to intelligent conclusions; and these were confirmed before the very eyes of Professor Sekiya by an occurrence which, though doubtless gratifying to that ardent seismologist, was not, as he drily remarked, a particularly comfortable incident of a solitary ramble. One day, while he was at work in the crater, a huge slice of the precipitous rear-wall that had been bared by the explosions fell of a sudden, quite near to but happily clear of him, and crashed with a tremendous uproar down the steep mountain side. This slab was about 1,000 feet high and of considerable thickness. He witnessed its fall and its long descent. He saw how the great masses of earth and rock were shattered as they fell, and broken up into bits ever growing smaller as the velocity and the distance increased and as the fragments were dashed against one another and against obstacles in their way, until they finally lost cohesion, and were reduced to a pulverised, almost impalpable state, not very different from that of sand. The behaviour of the mass now resembled the rush of a headlong torrent. Tough boulders, able to survive the ordeal, were of course mixed with the finer matter, and great rock masses from 20 to 30 feet in diameter were floated down on the surface. But, as a whole, the movement approximated to that of a fluid. No words, says the Professor, can describe the "fierc ness and force" of that magnificent and impetuous dow pour—its mad surgings this way and that, and the bol leaps with which it would now and then bound over lo hills that hindered its progress, and shot onward dow the neighbouring depression. Similar, though on a vast greater scale, must have been the awful avalanch which darted down from Sho-Bandai-san in two pri cipal streams on the fatal morning of the 15th of Jul These, it is now known, dashed over hills and ridg fully 100 feet in height, and Professor Sekiya's estima that they must have attained a velocity of nearly 50 mil an hour sufficiently accounts for the swiftness of th fate that befel the doomed peasantry in the uplands an valleys below. A part, doubtless, of the descendi matter, mingling with the waters of ponds and lakes its course, became a kind of mud, and may have bee thus assisted in its flow; while that which reached t Nagase river and swallowed up so many of the Nagasa villagers, acquired the consistency of a paste. But by f the greater volume was never moistened, and must ha derived its fluid or semi-fluid properties from a rap process of pulverisation, after the manner witnessed Professor Sekiya.

As for the crater, the researches conducted by t Japanese explorers now assigned to the disrupted mat dimensions far in excess of all previous estimates. form, the crater-bed is roughly that of a horseshoe, op ing northward, and inclined slightly down from the ap to the mouth, where it is nearly 1·5 mile wide. whole area is about 950 acres. Round the crown of shoe is a nearly vertical wall, 1,660 feet high, in front which everything has been blown away. But the p itself, which was 540 feet higher than the summit of crown, lay within the now empty space. Thus, the th greatest dimensions of this gigantic projectile were, spectively, about 2,200, 7,500, and 7,800 feet. From th and other particulars it has been possible to estimate v approximately both the volume and weight of the rupted matter. In my former narrative I ventured the statement that, assuming the mean depth of *de* over the buried area to be 15 feet, its weight would be less than 700 millions of tons. I added, however, t this depth was probably far short of the truth. It pro to be only about one-fourth of the truth. No fewer t 1,587 millions of cubic yards, weighing 2,880 millions tons, and spread over 27 square miles of country to average depth of 57 feet, are the approximate figu with which to estimate the power exerted in this la manifestation of plutonic energy. A great fissure, dou less corresponding with the original line of least resista runs through the crater from its vertex nearly to its mou It is marked by a long range of steamjets, large small, which puff and hiss forth immense volumes white, pungent vapours. But Bandai-san is now p fectly at rest. Delicate tromometers fail to detect faintest throb upon its surface. Only that row of remains to tell of the fever that rages far beneath.

The terrible *coups de vent* that accompanied the plosions, and wrought such havoc in the forests villages, were, of course, corresponding phenomena those which break windows and lay low the grass plants at the firing of ordnance forged by men. difference was one of degree only, though some idea its vastness may be gathered from the fact that in case villages many miles from the scene were liter wrecked, while in the forests near the crater hundr of trees, three or four feet in diameter, were laid prostrate on the ground. Suddenness, from first to last, characterised the whole of this remarkable phenomenon. There had been slight shocks of earthquake on the 8th, 9th, 10th, and 13th; also a momentary spasm at about seven o'clock on the morning of the eruption, so feeble, however, that many persons failed to notice it. Strange rumblings, taken for distant thunder, were heard in the mountains soon after seven. But of palpable warning there was virtually none, with, perhaps, the bare exception that animals in the neighbourhood are said to have shown signs of uneasiness and fear just before the outburst. That animals are highly susceptibe to minute tremors of the ground is a well-established fact; and, as the earth in the vicinity must have been more or less affected before such an explosion as that of Bandai-san, it is quite conceivable that there may have been a succession of microseisms perceptible only to the delicate senses of quadrupeds and other dumb creatures. Well-waters are said to have diminished in some places before the eruption occurred. But neither before nor after did the large Lake Inawashiro, to the south of the volcano, give any sign of being affected by it. And, generally, it must be owned that the Bandai-san catastrophe and the phenomena preceding it have not brought us any nearer than we were before to the power of saying when—or even where—volcanic mountains may be expected to give vent to their hidden fury.

Reviews.

Handbook of Sydney. For the Use of the Members of the Australasian Association for the Advancement of Science. Edited by W. M. Hamlet, F.I.C., F.C.S., Government Analyst. Sydney: Turner and Henderson.

Although this little book did not reach us until after the first meeting of the Australasian Association was over, it yet possesses a permanent interest as a compendium of the natural history—taking the term in its widest sense—of the Sydney district.

After an Introduction by the editor, dwelling on the topography of Sydney and the picturesque character of its harbour and vicinity, we find an essay on the climate by Professor H. C. Russell, Esq., B.A., F.R.S., the Government Astronomer. The temperature is decidedly lower than we might expect from the latitude. The mean temperature in the shade is only 62° Fahr., which is not greater than that of Toulon or Barcelona. But the summer of Sydney averages only 71°, and the winter 54°, whilst that of Toulon reaches a mean of 75° in summer, and falls to 48½° in winter. In the interior of the country the mean summer temperature is 66°, running up to 120° F. in the shade.

The average rainfall at Sydney is 50 inches, and the average number of days on which rain falls is 152. Further inland the rainfall decreases rapidly, being only 38 inches at Paramatta.

The account of the geology of the district, by C. S. Wilkinson, F.G.S., the Government Geologist, brings to light the fact that in the Pleistocene period the rainfall must have been more considerable than it is now, and that the climate must have been more favourable for the continuous growth of a luxuriant vegetation.

Professor J. H. Maiden, F.G.S., the Curator of the Technological Museum, furnishes a very interesting account of the botany of the region. He notes the deplorable fact that "no instinct of pioneering man seems to be stronger than his love of felling trees." Hence, in the neighbourhood of Sydney the native flora is becoming sadly restricted.

The mammalia of New South Wales are described by Dr. G. Bennett, F.L.S. With the exception of the Monotremata, forming as they do a transition between mammals and reptiles, they are not very interesting.

One of the few animal nuisances in Australia is the flying fox (*Pteropus poliocephalus*), a fruit-eating bat, which is very destructive in orchards.

The birds of Australia are overlooked in this manual, a fact greatly to be regretted.

The marine fauna, described here by Dr. W. A. Haswell, F.L.S., is extremely rich. It is much to be regretted that the Aquarium, founded by the exertions of the late Miclucho Maclay, has been allowed to collapse. This establishment, like those of Naples, Hoboken, etc., and unlike every aquarium in England, save that newly founded at Plymouth, was a place for genuine scientific research.

The insects of the Sydney district are well described by A. Sidney Olliff, F.E.S., of the Australian Museum. This writer notes the affinity which exists between the fauna of Australia and that of the western coast of South America. The paucity of species of butterflies—only 320 known species in so vast and so sunny a country as Australia—is something remarkable. Three species of *Papilio* occupy themselves with damaging the orange orchards.

The Hymenoptera, the Orthoptera, and the Diptera of Australia are not sufficiently known to be summarised.

From this little handbook it will be seen that an immensity of work remains to be done in Australia. We hope that the new Association for the Advancement of Science will, in the language of a homely old proverb, "do the next thing," that is the work which can only be done in Australia, and not waste its time and its energies upon subjects which can quite as well be studied in Europe.

An Essay on Cramming. By Robert W. Davey and R. H. Thompson. London: John Walker and Co.

Among our many national peculiarities one of the most striking and perhaps the most unfortunate relates to our system of education. Every one knows that, according to a scheme primarily imported from China, we treat examinations not as a test of the progress made by any student, but as the main object of education. We hear constantly of students preparing for some particular examination, and passing it or failing so to do. We constantly meet with elementary treatises in different branches of science written avowedly in reference to some particular examination, and we have a numerous and highly paid class of examiners. Until lately the public flattered itself that all this was as it should be; that if a man had passed such an ordeal he must be competent and conversely that if he failed he must be ignorant.

From this dream we are beginning to awake. No less eminent an authority than Professor Huxley told us a few years back that in these days we study not to know, but to "pass," the consequence being that we pass and don't know! This saying has been found to be true. Almost all men of eminence in science endorse it, and admit that a man may have passed a brilliant examination, say in chemistry, and yet be utterly incapable of extending the boundaries of chemical science, or of effecting any useful application of its truths. He may be, in fact, impotent alike theoretically and practically. On the other hand, men who have done great things, who have conducted important researches, and have become renowned as discoverers, admit frankly that they could not pass an examination in their own memoirs.

Nor is this surprising. Examinations, however fairly and ably conducted, can test merely a man's power of appropriating and remembering the results of others. They can throw no light on his mental resources, his suggestiveness, his ability to carry on successfully the inductive process. In other words, examinations pick out the brass and reject the gold. For what we want are discoverers and inventors, not mere walking vade-mecums who can talk glibly about some science, but can do nothing in it. Of course, those who might confess "ye know that by this craft we have our wealth" do not see these alarming truths. But there is still a "lower depth." Misleading as is examinationism, "pure, simple" competitive examination is worse. This system was adopted some time ago as the only key to minor appointments, civil and military, in the service of the State. The motive for the change was not the honest desire to secure the best men for the public service, but a wish to diminish the influence of the upper classes. Whether this wish was justifiable or not is a question which it is not within our scope to discuss. But we may certainly say that this diminution of aristocratic influence is being bought far too dearly. In order to secure very mediocre men we submit an increasing part of our youth to an ordeal from which, whether successful or unsuccessful, they emerge with unfeebled vitality.

So severe are the examinations, so irrelevantly extensive, that to pass almost necessitates the employment of a professional "crammer." This crammer is one who, by careful and constant scrutiny of the examination-papers and of the idiosyncrasies of examiners, can give an approximate forecast of what questions will be put, or at least what phase of any subject will be brought into prominence.

Thus, one examiner never repeats a question which he has ever put before; another constantly revolves in a narrow circle of questions, which may consequently be expected to recur periodically. One fixes his attention mainly upon the fundamental theories of a science; another confines himself to facts, a third to recent discoveries, and a fourth to practical applications. One has peculiar catches and traps against which the student can be warned. In short, a clever crammer—and without great cleverness no crammer can survive—can always tell his pupils what part of any subject they must carefully get up, or what parts they may safely neglect. Hence such pupils have an immense advantage over competitors who have carefully worked up the whole of the subject.

This at first sight may seem an evil. So, in one sense, it is; but the sin lies not with the crammer, but with the examiners and with the pedantic legislators who have called them into being. It is an awful fact that of the successful candidates for the India Civil Service a considerable proportion are found to be incapacitated by *morbus Brightii*, a consequence of severe brain-work under the pressure of anxiety.

We can recommend the pamphlet before us to our readers. It cannot fail to set them thinking

Abstracts of Papers, Lectures, etc.

ROYAL SOCIETY.

At the meeting on November 15th a paper on "Combustion in Dried Oxygen," by Mr. H. Brereton Baker, Dulwich College, late Scholar of Balliol College, Oxford, was communicated by Professor H. B. Dixon, F.R.S.

In 1884 some preliminary experiments, published in the "Journal of the Chemical Society," convinced me that moisture exerted an important influence on the combustion of carbon. Since that time experiments have been made, not only with that element but with several others, and the same influence seems to be exerted on the combustion of some, while no such influence could be detected in the case of other elements. It was discovered very early in the investigation that hydrogen, both free and combined, aided the union of carbon with dry oxygen, and therefore for the new experiments on this and other elements, special attention was devoted to their purification from hydrogen. It was found that two of these elements, amorphous phosphorus and boron, have, like carbon, a very great power of occluding hydrogen. To eliminate it, some of the elements were heated in a current of pure chlorine, while others were heated in sealed tubes with the chlorides of the elements, special precautions being taken to free the purified elements from all traces of the agents used in their purification. In this way the elements—carbon, sulphur, boron, and phosphorus, the latter in both red and yellow modifications—were found to have their combustion influenced by the dryness of the oxygen. Some chemical union was found to take place, the extent of which varied with the dryness of the substances. In no case, however, did it manifest itself by flame. Ordinary phosphorus was obtained so pure as not to glow in the oxygen dried by phosphorus pentoxide, though the pressure was increased and diminished in every possible way. If water was added, rapid combustion at once set in.

The elements—selenium, tellurium, arsenic, and antimony—were purified with as much care as was expended on the elements mentioned above. Their combustion was, however, not found to be affected in any way by the dryness of the gas.

In the course of the investigation two facts were discovered about the combustion: (i.) of amorphous phosphorus, and (ii.) carbon in oxygen. Amorphous phosphorus is generally regarded as being incapable of true combustion. It is asserted that before amorphous phosphorus can be heated to its kindling point, it changes into ordinary phosphorus, which then burns. This has been proved not to be the case. Amorphous phosphorus was heated in a current of nitrogen, free from traces of oxygen, to 260°, 278°, and 300°, in three experiments, without undergoing any change to the ordinary modification. If moist oxygen was substituted for the nitrogen, combustion took place at 260°. It seems, therefore, probable that amorphous phosphorus undergoes a true combustion in oxygen without previous change to the ordinary modification.

With regard to the combustion of carbon, it has always been a doubtful question which of the two oxides is first formed. Is carbon monoxide the first product, undergoing further oxidation to the dioxide, or is carbon dioxide the first and only substance formed? The problem seems incapable of direct solution. It is, however, open to indirect attack. When carbon is heated in a current of partially dried oxygen, a slow combustion goes on, and, though the oxygen is in excess, both oxides are produced. The amount of monoxide, however, is twenty times the amount of the dioxide. Experiments also show that this occurs at temperatures at which dry carbon dioxide is not reduced by carbon. The carbon monoxide must, therefore, be produced by the direct union of its elements, its further oxidation being prevented by the dryness of the gases. Confirmatory experiments were performed in which carbon monoxide was found to be produced by the slow combustion of carbon in air at 440°, a temperature too low for the reduction of the dioxide by carbon. It is probable that the ordinary combustion of carbon goes on in two stages, that carbon monoxide is first produced, and, if circumstances are favourable, this is further oxidised to carbon dioxide.

LEEDS GEOLOGICAL ASSOCIATION.

In his inaugural address, Mr. J. E. Bedford, F.G.S., gave an interesting account of *Natural gas*. He stated that the earliest record he could find of the discovery of natural gas in America was in Washington county, Pennsylvania, some sixty-five years ago. Some workmen were making a boring to obtain brine for the manufacture of salt, when, after obtaining the brine, small quantities of the gas made their appearance, but not in such quantities as to excite curiosity or produce any unusual effects. But suddenly large quantities of the gas rushed out and obliged the men to leave off working. The old account says that "the gas resembled hydrogen to all appearances, and that in effect it is similar to all that species of air that frequently collects in mines, known by the name of firedamp, which all chemists agree is hydrogen." Then an account of an accident is given, which, igniting the gas, illumined the country for miles around. Still no value was attached to this gas, and for years it was allowed to escape into the atmosphere, until some ingenious individual conceived the idea of fixing pipes to the mouth of the well and conveying the gas to the brine pans and boilers as fuel. From this time its economic value was recognised, and it is now used to a very large extent in many manufacturing districts, and especially in Pittsburg. In this city it is used for a great variety of purposes, such as warming dwelling-houses, cooking purposes, heating steam boilers, fuel for blast furnaces, etc. The gas is under considerable pressure, and pipes of only moderate diameter are required to supply large quantities of gas. For instance, a 40-horse power boiler is supplied with gas by a 2-inch pipe, the gas valve, too, being only half-opened. When the boiler is sufficiently heated, and the supply of gas adjusted, then little further attention is required. Mr. Bedford then related an instance showing the great utility and economy of this gas as fuel. Messrs. Jones and Laughlin, of Pittsburg, have 72 steam boilers and 90 puddling furnaces. They turn out per month about 5,900 tons of puddled iron, from Siemens and other furnaces 13,000 tons, and of steel 7,300 tons. All this metal was reduced to bars, plates, etc., the steam to run the heavy machinery being produced by the gas-heated boilers. Before the use of gas fuel, the consumption of coal was over 300,000 tons per annum. The whole of this vast establishment (where about 5,000 hands are employed) is now fed by a single gas-pipe, 20 inches in diameter, the pressure on which is only about 1 lb. on the square inch. The pressure varies somewhat at times, but is under control. The entire concern has been run on a pressure of three ounces to the square inch. The wonderful heating power of this fuel is due to the fact that a very large percentage (in some cases nearly 90 per cent.) of it is hydrogen, and, as is known, a given weight of hydrogen will produce in burning three times as much heat as the same weight of carbon. The value of this fuel in establishments of this kind, in comparison with coal, is dependent upon the conditions under which the two fuels can be obtained. It is estimated, however, that there is an average saving of from 60 to 75 per cent., of which one half is represented by the cost of fuel, and as much more by the cost of labour and material. The remarkable purity of this gas is another important feature in its favour, and for this reason it is especially valuable in puddling furnaces, where the iron is very liable to be deteriorated by sulphur, etc., from inferior fuel. There are also large glassworks using this natural fuel, and the owners find that they produce better glass and with greater economy than with any other fuel. In fact, there is not a single manufacturing establishment in Pittsburg of any importance which now uses anything but natural gas as fuel. The number of private residents who are using this gas for cooking purposes and for heating their houses, is very large and rapidly increasing. The supply of natural gas is derived from the Palæozoic strata, although it has been found in newer formations. The Trenton limestone of the Lower Silurian is very productive, although gas in some quantity is found in the shales above the limestone. From these shales, however, there is not a continuous supply, as they are generally in pockets. The difference between a good gas well or a poor one is due to the porosity or density of the Tranton limestone. Mr. Bedford here showed three specimens of this limestone. The first example was of a very spongy, porous character, similar in appearance to pumice stone. This was from the Kary well at Findlay, which produces 12,600,000 cubic feet of gas every twenty-four hours. The second specimen was porous, but not so much as the first one. This was from the Heck well, in the same neighbourhood, which produces between five and six million cubic feet per diem. The third specimen was a compact, hard limestone, showing hardly any porosity, and was from the Eastern Findlay territory. This well only produces half a million cubic feet per day. These specimens showed most clearly the comparative difference in the porosity and the density of the Trenton limestone, and the relation which these circumstances bear to the flow of gas. What has the Trenton limestone to do with this natural gas? Is it the source of its origin, or is it only from its porosity a vast passage or natural pipe line, so to speak, for the distribution or conveyance of this enormous volume of gas? He adhered to the theory that the gas is generated far below the Trenton limestone, and it can easily be supposed that with the tremendous pressure it is subjected to at its point of origin, it would force its way through the intervening strata until it reached this limestone, and then become distributed through it. The shales and slates above the limestone act as an effectual barrier to its further passage, until, either by natural fissures or by the agency of man, it finds a vent. As to the tremendous pressure alluded to, the well at Canonsberg, Pa., may be mentioned as having the greatest registered pressure of any in the world. The gas looks like a solid piece of blue steel for some distance after it comes out of the pipe. Solid masonry, 12 feet thick, surrounds the well to hold the cap on.

Very little was said in the first section of this paper on the chemical theories for the origin of this gas and petroleum, and therefore with great advantage the opinion of that truly great chemist and experimentalist, Professor Mendeléef, may be quoted. He thinks that petroleum is produced by water, which penetrates the earth's crust, and comes in contact with glowing carbides of metals, especially those of iron. The water is decomposed into its constituent gases, the oxygen uniting with the iron, while the hydrogen takes up the carbon and ascends to a higher region, where part of it is condensed into mineral oil, and part remains as natural gas, to escape wherever and whenever it can find an outlet. If this assumption be correct, and a sufficient store of metallic carbides be contained in the earth's interior, petroleum may continue to be formed almost indefinitely, and yield a supply of fuel long after coal has become exhausted. The Professor supports his views by producing artificial petroleum in a manner similar to that by which the natural product is made.

As to the life of a gas well, or, in other words, the length of time when gas will issue from it, only theories can be indulged in. We know that the flow of gas from these wells does diminish, still not yet so far as to discourage investors. The natural gas territory is of such vast extent that, should the life of the first wells drilled be comparatively short, others may be drilled in other parts of the district, and (approximately) the same amount of gas may be obtained. This has been demonstrated to be a fact, so far as present experience teaches. However, there seems to be a general opinion that, in process of time, all the gas wells will be exhausted. It is stated that there is not to-day a single gas well in Pennsylvania which is giving out 50 per cent. of the volume of gas which it originally did, and in many instances gas wells of enormous pressure when first opened have been abandoned. Mr. Bedford gave the following analysis of natural gas from Findlay, Ohio:—Marsh gas, 92·61; olefient gas, 0·30; hydrogen, 2·18; nitrogen, 3·61; oxygen, 0·34; carbonic oxide, 0·50; carbonic acid, 0·26; sulphuretted hydrogen, 0·20. This must not, however, be taken as the standard composition of this gas; it is very variable. Samples taken from one well at different dates have been found to vary in nitrogen from 23 per cent. to 0 per cent.; in carbonic acid from 2 per cent. to 0 per cent.; in oxygen from 4 per cent. to 0·4 per cent., and so on. This fact of variable composition has given rise to many interesting questions and theories.

GLASGOW NATURAL HISTORY SOCIETY.

The 37th annual general meeting of this Society was held on Tuesday, 30th October, Mr. Thomas King, Vice-President, in the chair. The Secretary, Mr. D. A. Boyd, read the report of the Council on the progress of the Society during the past year, which stated that the names of 5 honorary, 10 corresponding, and 111 ordinary members had been added to the roll, the total membership being 342. The various departments of the Society's work continued to be maintained in a satisfactory state of efficiency. Reports by the Treasurer and Librarian were also submitted and approved. Mr. A. Somerville, B.Sc., F.L.S., was elected a Vice-President, and other office-bearers were appointed. Mr. James J. F. X. King exhibited a partial albino blackbird shot in the neighbourhood of Kilbarchan, Renfrewshire. Rev. John Muir exhibited a series of ophidia and scorpionidæ from the south of India, and described the various sub-orders which the specimens illustrated. Mr. R. Broom, B.Sc., made some remarks on the snakes, and referred particularly to the rarer and most interesting forms. Among these were specimens of *Cynophis malabaricus*, *Passerita purpurescens*, and *Trimeresurus anamallensis*. A very fine series of the shells of *Isocardia cor*, one of the rarer marine mollusca was submitted for exhibition. Among the specimens was an adult, dredged in July, 1887, between Lesser Cumbrae and Brodick, and especially interesting as the first living example recorded from the Clyde. This was kindly lent for exhibition by His Grace the Duke of Argyll, K.G., K.T., D.C.L., F.R.S. Numerous other specimens, from various marine districts, were shown by Mr. David Robertson, F.L.S., F.G.S., President, Dr. John Murray, F.R.S.E., F.L.S., honorary member, Mr. W. Anderson Smith, corresponding member, Mr. James Paton, F.L.S., Mr. D. Corse Glen, C.E., F.G.S., and Mr. A. Somerville, B.Sc., F.L.S. A paper was read by Mr. Somerville in which reference was made to the various specimens, and a general account given of the species and its area of distribution. Mr. John Renwick exhibited fasciated main-stems of the Austrian pine (*Pinus austriaca*) grown on the estate of Traquair, Peebles-shire.

THE BOURNEMOUTH SOCIETY OF NATURAL SCIENCE.

At a meeting held on November 9th, the President (the Rev. G. H. West) in the chair, a paper was read by Mr. C. Carus Wilson on "Musical Sand." The lecturer referred to the history of musical sand, which has been noticed in writings for the last 1,000 years, and mentioned various localities where it is found, as at the Isle of Eigg, Gebel Nakus, near the Red Sea, Reg-Ruwan, and other places. It has also been found on the beach near Studland, as noticed by Mr. Carus-Wilson in *Nature*. These interesting and peculiar sands, on being struck with the foot, or put in a bag and struck, or even on drawing the hand through them, have the power, when dry, of emitting a shrill musical sound, quite distinct from the dull thud given by ordinary sand under similar treatment. Mr. Carus-Wilson has examined a number of these musical sands from various localities, and finds they have certain physical properties in common. These are: The individual grains are rounded, polished, of uniform size, free from coating of other minerals, with but slight admixture of angular grains, and entire freedom from fine gritty particles. Hitherto no good explanation of the cause of the musical sound emitted by these sands on percussion has been advanced, and on this question Mr. Carus-Wilson has been working and experimenting. He was led to formulate a theory, which he hopes may lead to a true explanation of the cause of this phenomenon, by noticing the peculiar shrill noise made by the pebbles on Chesil Beach when walking over them. At any point on this beach the pebbles are of uniform size—rounded, smoooth, and free from admixture of gritty particles, so that when disturbed by the foot they tend to slide from and over each other, rubbing their surfaces together, and by that action emit a shrill sound unlike the grinding noise from rough or angular stones under like circumstances. The lecturer showed that the physical characters of Chesil Beach, except for size and composition of its particles, are identical with those of a singing beach; and he thinks the rubbing together of the rounded particles of sand may be the cause of the sound emitted by musical sand. Mr. Carus-Wilson detailed experiments he had made in the course of his investigations. He had endeavoured to make a musical sand by sifting ordinary sand through muslin of various degrees of fineness, and afterwards treating it with acids. By this means he had obtained a sand composed of clean grains of uniform size, but which was not musical. The grains, however, were angular, and not rounded. It would appear there must be considerable difficulty in obtaining a successful result to such an experiment, as the musical properties of sand depend on most delicate conditions. The mere handling of such a sand is enough to make it mute, or if brought home and damped with water it is made for ever mute, which is very curious, as the same sand, exposed on its beach, is constantly exposed to the action of sea or rain water, and yet when dry is again musical. The Studland Bay sand is musical only on its own beach. Mr. Carus-Wilson has ›ught away many samples from that locality, but has ›er been able to bring with it its musical note. The ›d from the Isle of Eigg, first described by Hugh ›ller, appears to be one of the best and most famous of ›se musical sands. Of this the lecturer had a sample, ›ich, on percussion with the wood handle of a seal, ›itted a loud shrill sound. This sand is the result of the disintegration of the rocks in that locality, and has, through long periods of time, been subject to a separating ›ion by wind and wave. The result is, the coarser ›nded particles are left high, and constitute the sing- beach; the finer are carried away to another part of the bay, where they are found. In much the same way the ›ging beach in Studland Bay has been formed by the ›ion of the prevailing wind separating and carrying ›ay the finer particles of sand, leaving the larger ones, ›nding and polishing them by attrition. The delicate ›ditions necessary for the formation of a singing beach ›well shown here, where it is a rather long interrupted ›ip not more fifteen yards wide.

An interesting discussion followed, in which the ›esident, and Messrs. Dolamore and Curtis took part.

FLINTS.

THE second of a series of lectures on Flints was given on Monday evening of last week in the theatre of the School of Mines, by Professor J. W. Judd, F.R.S. ›e lecturer commenced by saying that at their last ›eting he endeavoured to point out how, by a series ›analyses, the chemist arrived at the conclusion ›t quartz consisted of silica, and nothing but silica. He ›en proceeded to point out that the substance silica, or ›xide of silicon, consisted of two chemical elements— the gas known as oxygen, and the solid substance known as silicon. He remarked upon the great interest which ›ached to those two elements—oxygen and silicon ›arising from the fact that oxygen constitutes one-half the crust of the globe, while silicon constitutes nearly quarter, those two elements by themselves making , therefore, three-fourths of the earth's crust. He ›en proceeded to point out the wonderful analogy there ›is between the element silicon and the element carbon. ›showed that while carbon formed the basis of the organic world, silicon constituted the basis of the mineral or inorganic world. He showed further that those two substances—carbon and silicon—presented some remarkable analogies one with the other. Those two substances were each capable of existing in a number of different conditions known as allotropic forms of the substance. The diamond was one form of carbon; carbon was sometimes found as a black substance—charcoal—and sometimes crystallised as graphite; sometimes, again, it is found in meteorites, which come to us through space in the form called Cliftonite. He showed there were three forms of silicon, analogous to the diamond, Cliftonite, and charcoal. Proceeding from the condition of the element silicon to the compound substance silica, he pointed out that silica was the most abundant of the binary compounds in the earth's crust—that it constitutes, either alone or in combination with other substances, no less than two-thirds of the earth's crust. He had then proceeded to point out that silica, like silicon—they must keep clearly in mind the distinction between the compound of silica and the element silicon—and carbon could exist in other states, and he had also briefly indicated, in concluding his lecture, that that difference between substances having the same ultimate chemical composition was principally due to the way in which their atoms or molecules were arranged in building up the substance, so that if the arrangement of atoms or molecules be altered without changing the chemical composition, of the substance they might completely alter its properties. Now there were two forms of silica which were especially worthy of their attention. There were other forms of silica, as he should point out presently, but there were two forms which in their study of flints they must especially bear in mind—the substance known as colloidal silica, a kind of gluey, jelly-like substance; and the crystalline, or ice-like form of silica. Now, colloidal silica and crystalline silica have identically the same chemical composition, but in a great number of points they differ remarkably in their physical and other properties. First of all he would refer for a moment to the differences of their chemical behaviour under different conditions. If he were to put a piece of crystalline silica into a vessel of water he might leave it there practically for an indefinite time, and it would undergo no change. There would be no tendency for the substance to dissolve, and as he pointed out last time, he could not dissolve it directly in any substance except in the powerful acid known as hydrofluoric acid. But colloidal silica might easily be made to pass into solution. He would call their attention to the case of minerals in the gallery above the theatre, where they would see water containing a considerable quantity of colloidal silica in solution. It appeared perfectly bright and clear; and they could not tell it from pure water. Now, there was another chemical difference between crystalline silica and colloidal silica besides the tendency of the one to pass into a solution and the other to resist solution. Quartz showed no tendency to combine with water, but colloidal silica did very easily combine with water. It was true that by raising the temperature to a certain extent some of the water separates from colloidal silica, but it is very difficult indeed to separate the whole of the water from that substance. Chemists had found out that there are very definite compounds of this silica, or dioxide of silicon, with water—one known as silicic acid, and others containing larger proportions of water.

Now, besides that difference of chemical behaviour, he must now call attention to the fact that there were many curious physical differences between quartz, or crystalline silica, and colloidal silica. The first was the difference of density, or weight, to which he must call their attention; and in comparing those substances they must compare either equal bulks of substance or else refer both to one common standard, and the standard which was chosen for comparing weights of solid substances was water. Now if he were to take a small cubical vessel of such a size that when it was filled it would contain just one pound of water, and then take a piece of quartz and cut it out in a block of exactly the same size as the interior of the vessel, so that it would fit into it and fill it exactly, if we weighed that quartz it would be found that it weighed considerably over a pound—that it would weigh exactly $2\frac{2}{3}$ lbs., or putting it in decimal instead of vulgar fractions, 2·66. Now, if we took the other variety, the colloidal silica, and treated that in the same way, it would weigh $2\frac{1}{5}$ lbs., or in decimals 2·2. Now they saw that these two substances differed in a remarkable manner in their density or specific gravity. As a matter of fact, it was a very troublesome operation, as they might imagine, to cut blocks of colloidal silica, or quartz, into definite forms to weigh them, and they could arrive at the specific gravity by a very much easier method. If we take a block of crystalline silica and weigh it carefully in a delicate balance in the air, and get its weight, and then take the same mass and sustain it in the vessel of water while it is being weighed, it will be found that the water will buoy up the mass, and that it will weigh less than when it was weighed in the air. It had been found that the diminution of weight when it was weighed in water was equal exactly to the weight of the bulk of the water which the block displaced. That very remarkable discovery is ascribed to Archimedes. We can determine the specific gravity of a body at once by making use of this principle. If the crystalline silica was weighed in air and then in water, they would have the weight of the displaced volume of water, and if we divide it into the weight of the substance we shall get the specific gravity. If we treat a piece of flint in that way it will be found that the specific gravity is always something less than that of quartz, or more than that of colloidal silica. Flint has a density between that of quartz and colloidal silica. Now, if the matter was made up of atoms or molecules — molecules being built up of atoms—and if the atoms and the molecules of the same substance have the same weight, then, knowing that colloidal silica and quartz, or crystalline silica, were built up of the same elements in the same proportions, they would arrive at the conclusion that if the one substance was lighter than the other it must be because there are more particles in a given space in one case than in the other; they would arrive at the conclusion that in colloidal silica the molecules did not lie so close to one another as they did in crystalline silica. And there were many facts which tended to bear out that conclusion. The first which he would call their attention to was this: If he took a piece of quartz and put it into water or any coloured liquid, such as ink for example, it would be found there was no tendency for the liquid to be absorbed by the substance crystalline silica. The ink could be washed off the surface, and it would seem to have undergone no kind of change. There was no tendency in crystalline silica to absorb the coloured liquid; there was no evidence that it was in any degree porous. But if they took a piece of colloidal silica and put it into liquid they would soon find that the colloidal silica tended to absorb the liquid without undergoing any change in its own bulk, that it exhibited evidence of porosity; and if they used a coloured liquid for experiment they would see that fact proved by the circumstance that the coloured liquid would permeate the whole mass of the colloidal silica. When he said that crystalline silica did not absorb a coloured liquid he did not refer to the existence of exceptional cracks such as were to be found in specimens of crackle quartz. If the crackle quartz were put into a coloured liquid the liquid would find its way into the cracks, and then it might give a portion of it a pretty appearance, but the liquid only penetrated along the cracks, and not into the substance of the mass. But colloidal silica appeared to be an absolutely porous substance, though some forms of colloidal silica were much more porous than other forms. One of the most porous forms of colloidal silica was a very singular form of substance known by the name of tabasheer. Tabasheer is the Arabic name for a very curious substance, which had a singular origin. They had heard that silica passed into solution under various conditions, and in quarters of the globe there was a certain quantity of silica in solution. Silica was taken up by the roots of plants, especially by certain varieties of plants, such as the grasses, and these grasses were capable of absorbing this colloidal silica, and building it up into their structures. Many of the grasses contained a considerable quantity of silica, in their stems especially, and sometimes particles of it exuded from the surface of the stem. There was a gigantic grass—the bamboo—that absorbs silica, like all other grasses, and builds silica into its structure. When the grass on the bamboo was burnt they sometimes got a considerable quantity of silica. Now he had to refer to a curious circumstance that sometimes occurred in the case of bamboos. Bamboo, like other grasses, consist of a number of joints which were cut off from one another, there being a central hollow cavity between the separate joints. Those rings were solid, and the spaces between were hollow. Now it appeared that when bamboos were in an unhealthy condition or had suffered from some kind of injury, the silica which was taken up in them might accumulate in those hollow portions of the stem, and thereby they got deposits of hard silica in the bamboo. It was only now and then that it is found. From very early times the Eastern peoples had been in the habit of looking for these deposits of silica in the joints of the bamboo, and they gave to it the name tabasheer. It was very highly prized by Arab physicians; and was taken internally. One did not know what good or harm it was likely to do; but he did not know that that might not be true of certain Western medicines. However, that substance was highly prized, and was sold in all Eastern markets. Now, this tabasheer was a curious form of colloidal silica. It was so porous that the pores were two and a half times the bulk of the solid silica which enclosed them. They very seldom found any form of colloidal silica so excessively porous as that, though all forms of colloidal silica were more or less porous. Now let them see how they could prove the porous character of the substance tabasheer. Sir David Brewster, who was the first to call attention to the curious properties of tabasheer, indicated some very valuable experiments by which its nature might be illustrated. He showed that if one took a small portion of the substance and put it into a liquid which was coloured red or blue by some colouring matter, this colouring matter would permeate the mass, which would be coloured throughout by the liquid passing into it. He showed that it could be coloured in another way. If a piece of the substance be wrapped up in paper, and the paper set fire to, smoke was produced, and this smoke would enter in through the pores of the substance and blacken the whole of the interior of the tabasheer. He would show them how that absorption took place in the case of tabasheer, but before doing so he would point out that there were many other forms of colloidal silica which exhibited some porosity, though to a less extent. There was a curious substance called hydrophane, that appeared dull and opaque when looked at under ordinary conditions, but if it were dropped into water it became almost perfectly transparent, and sometimes glowed with all the beautiful colours of the opal. When it was taken out of the water it lost that wonderful property, and became dull and opaque. Lately a variety of this substance, hydrophane, had been made use of in the United States; it was found in Colorado, and was used by our American cousins for making "magic" rings containing photographs; a small plate of the hydrophane is placed over a photograph. Under ordinary conditions the white opaque substance concealed the photograph, but if it be put into water the water was absorbed, and the whole mass would become transparent. They would have to consider why the substance became transparent when it absorbed water. One had a familiar example of it in a piece of blotting-paper, which appeared quite opaque when dry, but it became more transparent when it was wet. Now this hydrophane acted in just the same way. The curious property that colloidal silica had of absorbing liquids had long been known, and made use of in the artificial colouring of agates and similar substances. They would learn presently that those agates were made of bands of colloidal silica alternating with others of crystalline silica. Crystalline silica did not absorb liquid, but colloidal silica did. Certain coloured liquids could be introduced into that portion of the agates which consisted of colloidal silicate. There was a very great demand for the black variety of agate, which constituted what was known as onyx. Mourning studs and similar articles of jewellery were formed of that material. Perfectly normal black examples of this substance were found in nature, but not in anything like the quantities that were required for the purpose of making this mourning jewellery, and so at Oberstein the people had learned to colour those substances artificially, taking advantage of the porosity of colloidal silica. He would try and illustrate how that was done. The workmen took a stone which might be of a dull grey tint, with no beauty about it at all, and put it into a substance like a solution of sugar or honey, keeping it at a gentle heat by placing it upon a stove. It was found that three weeks was often required for such a substance to pass into the pores of the dull-looking agate. When the sugar or honey has passed into the interior another substance is introduced—oil of vitriol or sulphuric acid—which penetrates in after the sugar and produces a wonderful change. When a solution of sugar was treated with sulphuric acid the water was taken away from the sugar and the black carbon was left behind.

Now, he thought he had brought forward sufficient facts to illustrate that colloidal silica which existed in agates was more or less porous in its structure. He must point out that there was a very interesting quality of colloidal silica, which was probably accounted for by the fact that it contained a great number of little pores. Colloidal silica possessed in a remarkable manner the property known as opalescence. If one looked at a mass of colloidal silica it would be seen that it had a milky-blue tint when the light was on it, but if the light be allowed to pass through it, it has more or less of a yellow tint. That peculiarity, that the object looked blue by reflected light, while it appeared yellow by transmitted light, was known as opalescence; and one of the most wonderful examples of this was the air itself. In the daytime the atmosphere, throwing back the light of the sun, appeared blue, and thus they saw the blue sky; but when the sun gradually declined in the heavens and passed towards the west the light passed through great thicknesses of atmosphere, and the sky then appeared first yellow, and then red, and all the beautiful colours of the sunset were displayed. He must not follow out the question which had been suggested by Dr. Tyndall and other physicists, who had shown that this opalescence of the atmosphere and all other forms of opalescence were due to minute foreign particles scattered through the atmosphere or through the liquid which exhibits the opalescence. A simple experiment would, perhaps, render that tolerably clear. He had a vessel of water, and in the bottle there was a quantity of resin dissolved in spirit. That substance remained dissolved in the spirit, but it would not dissolve in water. When introduced into the water it was broken up into a countless number of very minute particles, those particles acting upon the light in such a manner as produced opalescence. That quality had received the name of opalescence because it was exhibited by the special form of colloidal silica which was known as opal.

Both the colloidal forms and the crystalline forms presented very beautiful colours. Those colours were, like the opalescence appeared to be, in all cases due to the presence of very minute foreign substances. Sometimes quartz presented a beautiful greenish tint, at another time an amethyst or purple tint, at other times a bright yellow colour, and at other times it becomes dark and almost perfectly black. But he would strongly recommend them to examine the wonderful varieties presented in that substance in the horse-shoe case in that museum. He hoped that after some of these lectures they would take the opportunity of seeing the wonderful beauty and variety of the forms of silica which were there exhibited. How small a proportion of foreign substance might produce a large amount of colour was illustrated by two vessels on the table. In one he had placed a pennyworth of gold, and in another one-fourth of that quantity, yet it was sufficient to colour a large mass of liquid. Doubtless many of the colours found in quartz, which were very brilliant and beautiful, were due to equally small proportions of foreign substance diffused through it. Opal presented, in addition to the quality of opalescence, which was shown in nearly all forms of opal, a wonderful play of colours. There was every reason to believe that that wonderful play of colours was produced by the presence of excessively minute foreign particles, which gave rise to the wonderful phenomena known as interference colours.

While speaking of the colours of these substances he might point out that they had there sufficient proof of the excessive minuteness of these ultimate molecules or atoms of matter. If one took a piece of musk and put it into a room it would scent a large room for year after year, and every person who went into the room would smell the musk, because minute portions were separated and had come into contact with the membrane of the nose. Yet if one weighed the musk it would not be found that it had lost appreciably in weight. They could imagine how excessively minute must be the particles which, though being constantly separated, did not diminish the weight. Those minute particles of gold coloured liquid uniformly; they could not be discovered by the aid of a microscope, and they could thus form some idea of how minute those ultimate atoms and molecules of matter must be. Now, those molecules and atoms being so small they, could not study their positions and relations to one another, and the way in which they were built to form such a substance as colloidal silica on the one hand, or crystalline silica on the other, by the aid of the microscope or by any direct means; but there were means by which they could determine the way in which those ultimate molecules of matter were built up to make those substances, and he would endeavour to illustrate how it was done. Light comes to us through the undulations or waves produced in the ether which surrounds us everywhere. These minute waves, or pulsations, in the ether gave rise to the phenomenon known as light, and are of excessively small dimensions. The waves that produced sound or that they saw in liquid were all gigantic as compared with the waves and undulations in the ether. By allowing light to pass through the various substances, and studying the effects produced, they were able to tell how those particles were arranged.

By means of the lantern the lecturer then proceeded to show how light was used for making out the internal structure of solid bodies (polarisation of light). The reason why those colours were reproduced was that the molecules were built up in a certain fashion. Here they had the means of finding out the way of the building up of the molecules in the substance, and when pieces of quartz were examined in that way they were often found to have an exceedingly complicated structure. If they found opal, or colloid silica, occurring naturally, they never noticed in it any tendency to exhibit definite outward forms. The mass broke out into irregular fragments, without any tendency to form definite shapes; but when they found the other kinds of silica they constantly saw in it a tendency to take on those wonderful forms which belonged to what were called crystals. In virtue of the wonderful inward molecular structure they got produced an outward form. Crystal forms are, indeed, the outward and visible sign of the inward molecular structure which existed in quartz, and distinguished it from colloidal silica; and it was wonderful how completely its outward form did betray the inward structure. There were a great many internal structures in different kinds of quartz, giving rise to most wonderful appearances when examined by polarised light. When these different varieties of quartz were forming crystals they found the crystals possessed certain peculiarities, a little extra face or other abnormal character, that betrayed at once to the practised eye the fact that the quartz had its peculiar molecular structure; so that this tendency to take on the outward form of a crystal was connected with its wonderful molecular structure, which was betrayed by the substance und[er] polarised light. But the substance he had been referri[ng] to was not the only form of crystalline silica. Th[ere] were others. One was known as tridymite, and the[re] were other substances which were crystalline, all [of] which differed in their properties. So they could s[ee] what a wonderfully complicated substance the crystalli[ne] forms of silica were. In conclusion, he must refer [to] some physical properties which flint presented in a ve[ry] marked manner. As he pointed out in his first lectu[re] the character which distinguished flint above all oth[er] things was its hardness. The hardness of flint was n[ot] quite so great as that of quartz, but it was somewh[at] greater than that of opal. If a piece of flint was stru[ck] against another piece of flint or against a piece of steel [a] spark was produced. A minute portion of the flint or st[eel] was separated; the violent blow produced heat sufficie[nt] to cause this particle to become red-hot. Now, the hard[ness] of flint was combined with another property, whi[ch] gave rise to the uses to which flint had been appl[ied] in the past. It was not only hard, but it was to a certa[in] extent tough; therefore flint could be used as a cuttin[g] tool in a way that glass could not be used. But the mo[st] striking point about flint was its fracture—the way [in] which it broke. Different substances broke in ve[ry] different ways. Some crystalline substances broke ve[ry] easily in some directions, and they got what was calle[d] cleavage. Quartz would not break in a particular manne[r]. If one threw a pebble at a plate-glass windo[w] the result would probably be that on the other sid[e] of the plate-glass a little conical piece of gla[ss] would drop out, and with a larger piece of gla[ss] struck suddenly he might get a cone, the ang[le] of the cone being about 110 degrees. Sometimes a suf[fi]ciently violent blow might result in the forms of tw[o] cones, one having sides at an angle of 110 degrees, an[d] the other the sides at an angle of 30 degrees. Occasiona[lly] if a blow was struck obliquely he might get a cone lyi[ng] in an inclined position. This was a very peculiar pr[o]perty of flint. If a considerable mass of flint was struc[k] they might get the tendency of the forms of a con[e] giving rise to the appearance exhibited by the outside [of] a shell, and that fracture was known as a conchoid[al] fracture. Sometimes if a light tap was given on th[e] surface of the flint, instead of getting a single cone, the[re] was around it an inverted cone, producing a cup so th[at] it looked like a little cone and crater, such as one saw i[n] volcanic countries. The conchoidal structure of flint wa[s] a very remarkable one, and it was this property com[]bined with hardness and toughness which enabled the[m] to use it in various ways. If flint was struck with [a] hammer a flake was obtained (specimen exhibited). [It] was the fact of the flint having that peculiar fractur[e] which had enabled it to be employed for purposes whic[h] he would have to describe in a future lecture. He hope[d] in the next lecture to show how the microscope enable[d] them to learn more about the internal structure of flin[t] and its relation to those two substances which they had been considering that evening—colloidal and crystalline silica.

INSULARITY.—Says the Rev. H. H. Slater (*Midlan[d] Naturalist*), in a series of articles bearing this title, "I[n] no other country of which I have any experience is th[e] scientific worker treated by the Legislature with suc[h] contemptuous indifference as in this."

RECENT INVENTIONS.

The following list has been compiled especially for the SCIENTIFIC NEWS *by Messrs.* W. P. THOMPSON *and* BOULT, *Patent Agents, of* 234, *High Holborn, London, W.C.; Newcastle Chambers, Angel Row, Nottingham; Ducie Buildings, Bank Street, Manchester; and* 6, *Lord Street, Liverpool.*

GAUGE.—Mr. H. Nash has patented a liquid gauge for gauging the contents of vessels. It comprises a spiral rod, which is rotated by a nut sliding longitudinally thereon, and which cannot rotate. This nut is operated by a suitable float, to which it is attached, the float being guided by a tube forming a case for the instrument. An index is attached to the head of the spiral rod, and is adapted to move over a dial secured to the upper end of the tube.

INSULATING WIRE.—Mr. W. S. Smith has patented apparatus for insulating or covering wire. The apparatus consists essentially of a drum, into which the material is fed by rollers or other feeding mechanism, and within which are a toothed ring and a pinion gearing together, one of them being driven from without, and also a partition, past which the material is carried by the teeth of the ring and pinion, and is forced out towards a die, through which the wire is led.

ELECTRIC LAMP.—Mr. T. A. Edison has patented a cut-out device for electric lamps. The lamp is constructed, in the usual manner, of a glass vacuum chamber and a carbon filament placed therein, but in carrying out this invention it is also provided with a spring cut-out held out of action by a fine wire situated between the leading-in wires, whereby when the wire is fused, by the filament of the lamp breaking, the cut-out is released, and the lamp is cut out of circuit, which prevents the destruction of the lamp and its socket and the continuity of the series circuit.

CLEAR WATER FROM RIVERS.—Mr. S. A. Johnson has patented a method of obtaining clear or filtered water from rivers and other sources. For this purpose a float is employed which floats on the surface of the river and carries a perforated chamber at any distance below the surface. This chamber is connected by a flexible pipe with a filter, from which a pipe descends into a vessel which is at such a level as to enable the water to be drawn off by syphon action. By adopting this method both the surface *debris* and the bottom mud or other matter are avoided.

LITHOGRAPHY.—Mr. J. L. Mills has patented a method of lithographing by sand-blast. The lithographic stone is coated with gum of suitable thickness, upon which, when dry, is placed a tracing of the picture it is desired to engrave on the stone. Then by directing the sand-blast in proper manner the gum is punctured in an artistic manner until the whole of the tracing and light and shade appear to be perforated through the gum and into the stone. After this, lithographic grease is poured over the coated stone, thus imperforating the punctures. The gum is then washed off with water and the stone etched in the ordinary way.

REMOVING SCALE.—Mr. H. J. Haddan has patented an apparatus for removing scale from pipes and tubes, on behalf of Herr A. Rast, of Austria. This implement comprises a shaft adapted to be rotated by a crank handle at one end. Its other end carries a block sliding thereon which has pivoted on it plates ending in gudgeons, on which rotary cutters or files revolve. Upon the end of the rod is a plate which is arranged to bear upon and press radially the plates of the gudgeons. The latter are preferably inclined, so that the cutters revolve in planes inclined somewhat spirally to the walls of the tube within which the implement is inserted and operated.

PHONOGRAPH.—Mr. G. L. Anders has patented a phonographic apparatus. The invention relates to the preparation of surfaces for receiving a phonographic record. The diaphragm employed in this improved apparatus is perfectly flat, and is made of lighter materials and more sonorous than the iron plate usually used; the recording instrument has a cutting or shaving edge, and the recording material is hard wax. This material has a continuous projection, and in combination with the cutting of the diaphragm forms the phonographic record. To guide the material against the style or cutting edge a threaded or toothed guide is employed, which is fastened to the frame carrying the diaphragm.

DISTRIBUTING MOTIVE POWER.—Herr V. Popp has patented an improved method for distributing motive power by compressed air, and for utilising this motive power for generating electricity. It relates to the arrangement of the apparatus employed, and its object is to ensure great efficiency and regularity of distribution. It consists essentially in the combination of a syphon retaining the water which may accompany the air into the conduits with an automatic regulator for controlling the pressing of air in the conduits in accordance with the resistance in the circuit; it also combines an apparatus for heating the compressed air before it passes into the motor, so as to increase the efficiency of the motive fluid.

MOTORS.—Messrs. H. Rogers and E. J. Curtin have patented an improved construction of high-speed, single-acting, high-pressure, or compound, or triple expansion engine. For compound the high and low-pressure cylinders are so arranged that there are two diametrically opposite low-pressure cylinders, the pistons of which are connected rigidly to a central loop in which works a crank on the engine-shaft, while the high-pressure cylinders have their pistons connected by rods to the same or different cranks on the engine-shaft, the supply of steam to the high-pressure cylinders being regulated by a disc valve, while the passage of the steam to the low-pressure cylinders is effected through parts governed by the pistons of the high-pressure cylinders.

FORGING METALS.—Mr. M. Gledhill has patented a novel method and machine, whereby metals can be forged either hot or cold. For this purpose rollers are used by and between which the metal ingot is rotated and moved endwise while subjected to the required pressure. The machine has a strong bed, upon which are bearings for the mandrel or bar being worked; these bearings are adjustable in all directions. Three rollers are employed, which are supported in bearings in suitable standards secured upon the bed. These rollers are arranged at equal distances apart, in such a manner that the tube being operated upon extends centrally between them. The rollers, or one of them, must have the bearings adjustable radially in the standard, so that they can be made to approach or recede from the centre of the space between them, and thereby caused to exert greater or less pressure upon the metal.

ANNOUNCEMENTS.

BOURNEMOUTH SOCIETY OF NATURAL SCIENCE.—This Society invite contributions on the following: (1) The fertilisation of the Coniferæ; (2) The fertilisation of the Ericaceæ; (3) The common forms of fresh-water Algæ found in the district; (4) The common forms of microscopic life; (5) The constancy or variation in form of pollen grains in a natural order, *i.e.*, how far is the shape of a pollen grain characteristic of an order; (6) The micro-fungi attacking plants; (7) Micro-section cutting; (8) Household waste in the things we throw away; (9) A process for softening water, the best adapted for domestic use; (10) Mimicry in nature; (11) The relation of insects to flowers; (12) Common forms of marine zoology found in this district; (13) Variation in insects; (14) Larvæ breeding, noting the effect of different kinds of food and degrees of light upon colour of the perfect insects, manner and times of feeding, sleeping, moulting, and putating, etc.; (15) Gall collecting, and Cynips breedings; (16) Indoor and window entomology, including two-winged flies, beetles, moths, parasites, bees, etc.; (17) Notes on the botanical geography of the district, on the rate of coast denudation, and the effect of the S.W. winds on the currents and tides.

DIARY FOR NEXT WEEK.

Monday, *Dec.* 3.—Royal Institution, Albemarle Street, at 5 p.m.—*General Monthly Meeting.*
Society of Chemical Industry, Chemical Society's Rooms, Burlington House, at 8 p.m.—*The Analytical Examination of Water for Technical Purposes*, by Mr. A. H. Allen.
Victoria Institute, 7, Adelphi Terrace, Strand, W.C., at 8 p.m.
Society of Arts, John Street, Adelphi, at 8 p.m.—*Light and Colour*, by Captain W. de W. Abney, C.B., F.R.S.
Society of Engineers, Westminster Town Hall, at 7.30 p.m.—*High Pressure Steam and Steam Engine Efficiency*, by Mr. W. Worby Beaumont, M.Inst.C.E.

Tuesday, *Dec.* 4.—Society of Biblical Archæology, 9, Conduit Street, Hanover Square, W., at 9 p.m.
Zoological Society of London, 3, Hanover Square.—*On the Mammals obtained by Mr. C. M. Woodford during his second expedition to the Solomon Islands*, by Mr. Oldfield Thomas, F.Z.S.—*On certain Points in the Structure of Clitellio (Claparede)*, by Mr. Frank E. Beddard, F.Z.S.—*On the Distribution and Morphology of the Supernumerary Phalanges in the Anura*, by Prof. G. B. Howes and Mr. A. M. Davies.—*On the Natural History of Christmas Island, Indian Ocean*, by Mr. J. J. Lister, F.Z.S.
Institution of Civil Engineers, George Street, Westminster, at 8 p.m.—*The Influence of Chemical Composition on the Strength of Bessemer-Steel Tires*, by J. Oliver Ar F.C.S.

Wednesday, *Dec.* 5.—Entomological Society, 11, Chandos St Cavendish Square, W., at 7 p. *Monograph of the Genera Conne Tinægeria, Wlk., with Eretruscera, Z* Lord Walsingham, F.R.S.—*Incidente servations in Pedigree Moth Breedi* Mr. Frederic Merrifield.—*Descriptio variety of Ornithoplera Brookiana*, b Rev. Dr. F. A. Walker, F.L.S.—*M graph of British Braconidæ, Part* by the Rev. T. A. Marshall, M.A.-*New Species of Lepidoptera from Kruk* by J. H. Leech, B.A., F.L.S.
Civil and Mechanical Engineers' So Westminster Palace Hotel, at 7 p. *Presidential Address.*
Society of Arts, John St., Adelphi, at 8 —*The Graphophone*, by Mr. H. Edm

Thursday, *Dec.* 6.—Chemical Society, Burlington Hou 8 p.m.

Saturday, *Dec.* 8.—Physical Society, Normal School of Sc South Kensington, at 3 p.m.—*On Facts connected with Systems of Sci Units of Measurement*, by Mr. T Blakesley.

METEOROLOGICAL RETURNS

for the ten weeks ending on Monday, Nov. 19th, 1888. Specially prepared for SCIENTIFIC NEWS from official rep

	Mean Temperature.	Rainfall.	Duration of Sunshine.
Scotland, East	46 8 degs., being 1·7 degs. above average.	5 6 ins., being 1·9 ins. below average.	170 hrs., being 32 hrs. below av
England, N.E.	47·7 „ „ 0·2 „ below „	4·1 „ „ 2·4 „ „ „	193 „ „ 6 „ above
England, East	48·5 „ „ 1·3 „ „ „	3·9 „ „ 2·5 „ „ „	153 „ „ 19 „ „
Midlands ...	47·7 „ „ 1·1 „ „ „	4·8 „ „ 2·0 „ „ „	214 „ „ 1 „ „
England, South	50·2 „ „ 0·4 „ „ „	5·8 „ „ 1·2 „ „ „	249 „ „ 24 „ „
Scotland, West	48·2 „ „ 0·3 „ above „	7·7 „ „ 3·2 „ „ „	174 „ „ 20 „ below
England, N.W.	48·7 „ „ 0·9 „ below „	6·1 „ „ 3·1 „ „ „	197 „ „ 2 „ above
England, S.W.	50·7 „ „ 0·3 „ „ „	8·1 „ „ 2·6 „ „ „	248 „ „ 13 „ „
Ireland, North	50·0 „ „ 0·8 „ above „	5·5 „ „ 2 9 „ „ „	179 „ „ 21 „ below
Ireland, South	50·6 „ „ 0·3 „ „ „	6·4 „ „ 2·4 „ „ „	211 „ „ 18 „ „
The Kingdom...	48 9 „ „ 0·1 „ below „	5·8 „ „ 2·4 „ „ „	199 „ „ 3 „ „

Scientific News

FOR GENERAL READERS.

Vol. II. DECEMBER 7, 1888. No. 23.

CONTENTS.

SCIENTIFIC TABLE TALK.

By W. Mattieu Williams, F.R.A.S., F.C.S.

Dr. A. S. Hudson (see page 509 of this magazine) cites the case of a herd of five cows to which salt was given every Sunday, the cows always appearing at the gate on that day for the customary dole, and infers therefrom that they counted the days between, as they were far from a house, and there were no differences shown between the doings of Sunday and working days.

Another and more probable explanation may, I think, be found in the ordinary physiological law of periodical recurrence of appetite. Artisans who dine punctually at 1 p.m. have an internal timekeeper that indicates the approach of that hour. Bricklayers, etc., whose dinner-hour is at mid-day are similarly warned one hour earlier, and those who dine in the evening have stomachs that are correspondingly educated. Ladies who indulge freely in five o'clock tea complain of a craving for that popular stimulant when the hour arrives.

A farmer friend, who is very successful in stock-rearing, tells me that one of the secrets of his success is punctuality in feeding those that are stalled for market. Immediately the feeding-time arrives the animals begin to "fidget," and if the feeding is delayed only a quarter of an hour they lose weight by the "dissipation of energy" due to such fretfulness.

The desire for salt is very strong among cattle that feed in hilly countries, and its supply is necessary for the maintenance of their health. In Norway this desire is utilised as the means of collecting the goats and cows for milking, especially at the "sæters," or upper pastures, where the requirement is strongest. The girl in charge of the sæter goes to the milking-place, dips her fingers in her pocket filled with salt, and the animals already assembled there, crowd around her to take their "licks." I have seen quite a pyramid of struggling goats concealing the girl altogether by climbing on each others' backs. Punctuality is observed in this both by the cattle and the milkmaid.

On pages 342 and 343 is an article on "Domesticity of Animals," in which three classes are enumerated, the third being that in which the animal is not merely the chattel, but the companion and friend of its owner; as the dog, cat, mungus, the parrot, and a few song-birds.

The writer proceeds to say that "it is a curious fact that no ruminant animal can be admitted into this class; pet lambs, kids, fawns, etc., always grow vicious as they reach maturity, and have to be consigned to the butcher."

This is usually true, but not unexceptionally so. A remarkable exception occurred some years ago in the case of a lamb that for some reason was spared by a butcher in Jermyn Street. My acquaintance with the animal commenced when it was full grown. It was then in the habit of following the butcher's man through the streets like a dog, like a well-trained dog, as it kept close to the man's heels. It was well known throughout the neighbourhood. I am sorry to add that its habits otherwise were not exemplary. I have seen it devour very eagerly a raw mutton chop, and suspect that this perverted appetite was the fundamental source of its devotion to the man in blue clothing. If a piece of beef or mutton and a handful of grass were placed side by side this docile creature ate the flesh first.

The case is instructive, and available for vegetarians as a reply to the argument for flesh-feeding, based on the supposed "natural" appetite of civilised man for flesh, as it shows how greatly the natural vegetarian appetite may be perverted. On the other hand, it seriously damages the vegetarian's assertion that flesh-feeding provokes ferocity, and that pure vegetable diet promotes the virtues of gentleness and amiability; for this cannibal was peculiarly gentle and docile, and did not, like those described by the author of the quoted article, grow vicious as it reached maturity.

My own theory of the difference pointed out by that writer is simple. Ruminant animals do not, in the ordinary course, enter into the third class of domestic animals, simply because they help themselves to their food. Those that become "the companion and friend" of man do so simply because they are fed by man with food more or less prepared by man, and in most cases directly supplied from his hand.

I have thus tamed many unlikely animals—frogs, toads, and more particularly those pretty and much-libelled legless lizards, the "slow worms." These reptiles have so far advanced in docility as to lose their ordinary timidity and come towards me for their food, in some cases to take it from my hand. Fishes may be similarly tamed.

I recently had a curious pet named "Waddle." He was the only outcome of a sitting of duck's eggs placed under a hen, and was consequently reared "by hand" in the house. Before arriving at mature drakehood he was turned out among the fowls, but treated them all with supreme contempt, while showing a dog-like love of human society. I was his especial favourite. My summer reading-seat was under a large elm, where Waddle always sat at my feet. If I walked round the garden he followed me; if I ran he stretched his wings half flying to keep up with me. He was a show bird whose performances were exhibited to all our visitors. My superior place in his affections was explained by the fact that I cultivated my own garden, and in the course of digging turned up many fat worms, that were always handed to Waddle.

When he was about two years old I purchased for him a couple of wives, pure specimens, like himself, of the white Aylesbury breed. They were brought to him in a basket, and were the first of his own species he had ever seen. Here was an experiment to test the theory of instinct resulting from inherited memory. According to this he should have fallen in love with them at first sight. He was in a pen bounded by frames of wire netting when the two ducks were introduced. His terror was so ludicrous that the witnesses of the experiment were convulsed with laughter. At first he rushed into the sleeping-place, and when the ducks followed him came out and flew over the hurdles as though the invaders were duck-eating vultures or other birds of prey that "inherited memory" had rendered terrible by instinct.

My lizard pets—the misnamed "slow worms" or "blind worms"—were very interesting. I had several, and they varied considerably. One of them was remarkably docile, its ordinary habits quite changed, habits that appear to be little understood even by good naturalists.

They are burrowing animals, residing in tunnels made in soft soil. They feed on slugs and earthworms, slugs preferred, are neither slow nor blind, but, on the contrary, are remarkably keen sighted and vivacious. Mine were kept in a disused aquarium half filled with soil. At first they vanished at the approach of footsteps, but I trained them by placing slugs at the mouths of their tunnels. Presently they lurked in these with head protruded, which was withdrawn on my approach. Gradually they ceased to fear me, and to regard me as a purveyor of slugs. My best pupil came out and licked my finger, which had been anointed with slug-slime in order to secure his affections. Ultimately it submitted to handling, and would coil round my finger and lick it with as near an approach to affection as such an animal could manifest.

All were short-lived—one till two years—and all died in the same manner. They were found lying on the surface with lack-lustre eyes and languid movement. My theory of their popular names is that the foolish rustics who persecute them as poisonous reptiles only see them when in this moribund condition, and imagine such to be their ordinary state—a very shallow conclusion, seeing that if it were so their extermination would have been consummated long ago. They only survive the stupid persecution to which they are subjected by virtue of their nimbleness. I strongly recommend their cultivation in gardens and greenhouses for keeping down the numbers of mischievous slugs.

THE VIADUCT OF GARABIT.

We give an account of the great viaduct of Garabit, with illustrations for which we are indebted to the courtesy of our contemporary *La Nature*. We shall describe how the great central arch has been put in its place, and what system was adopted for raising this enormous mass.

The central arch of the viaduct constructed by M. Eiffel is of 165 metres span, and rests on two great piers with six stages, the metal portion being more than 60

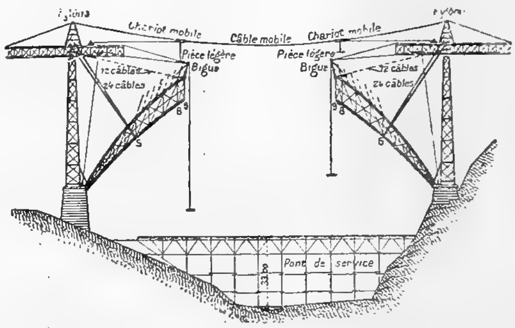


Fig. 1.—Method of Erecting the Arch.

metres in height; the total weight of the arch and its piling is about 1,165 tons.

The piers were first built, and then the ribs of the arch were put together on raised embankments. The next step was to hoist these ribs so that one end should rest on each pier, and the other end be in the position required for the arch. Each of these ribs thus placed was secured firmly by means of 28 cables of steel wire, moored to the abutments of the viaduct.

This being done, two scaffolds were erected which formed centerings which followed exactly the curve of

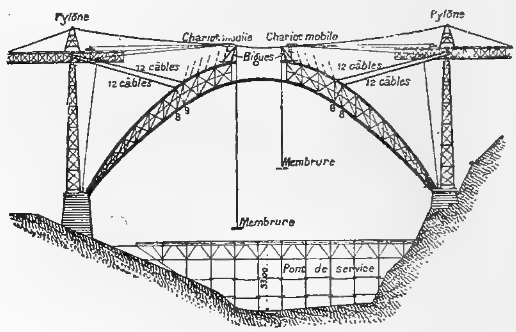


Fig. 2.—Last Phase in the Erection of the Arch.

the under-side, or intrados, of the arch. Upon these centerings were placed the various metal parts required for the cross girders and framing, and they were put together while the ribs were vertical, and afterwards lowered to the angle required by means of twenty steel cables. Afterwards the building of the arch with the ribs inclined was proceeded with according to the system previously adopted by M. Eiffel for the Douro Bridge. Step by step the new parts were attached to those already fixed, care being taken to rig up a new set of cables when the weight became considerable.

By means of the cables it was possible to raise or lower the parts of the arch which were being erected at any stage of the proceeding. The cables were controlled by hydraulic presses, and collectively formed an apparatus capable of moving masses of over 400 tons by a series of successive efforts never exceeding 15 tons.

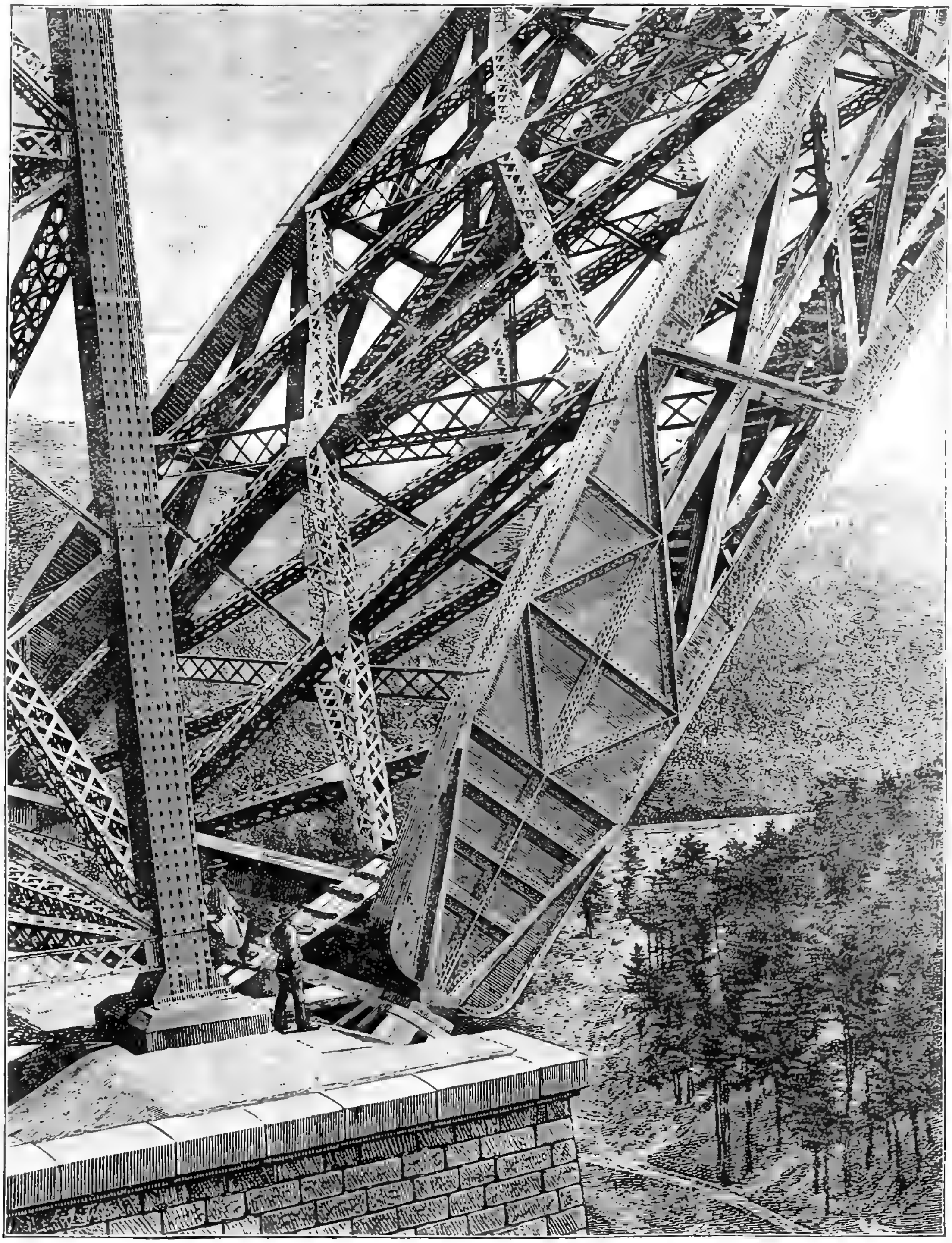


Fig. 3.—Spring of the Arch.

The completion of the intrados, or underside, of the arch was effected on April 20th, 1884, and all the cables were immediately slackened in case a fall of temperature should produce excessive strains either in the cables or in the arch itself. On April 25th a little lattice-work and a few other parts not yet in position at the crown of the arch were fixed, and the next day all was ready for introducing the key of the extrados, or upper side, of the arch. The hoisting of this key-piece was begun at 3 p.m., and at 7 p.m. it was in its place. With a few blows from a hammer it gradually assumed its right place, and the numerous holes for the two joints were perfectly true. The operation thus succeeded with a precision which might almost be regarded as mathematical, considering the magnitude of the work and the conditions under which the erection had to be performed.

We have only to mention the trials which took place in April last, before the viaduct was opened for traffic. These trials were of two kinds: in the one the loads remained stationary, and in the other they were rolling. The trial loads consisted of a locomotive of 75 tons, drawing trucks of 15 tons each, and the results obtained show the exceeding firmness of the work. The arch, loaded over its entire length with a train of 22 trucks, weighing 405 tons, showed a deflection of only 8 millimetres. The same train, placed upon one of the half-lengths of the arch, caused a deflection of only 4 millimetres at the crown, and finally, under the action of the rolling load the deflection was only 12 millimetres.

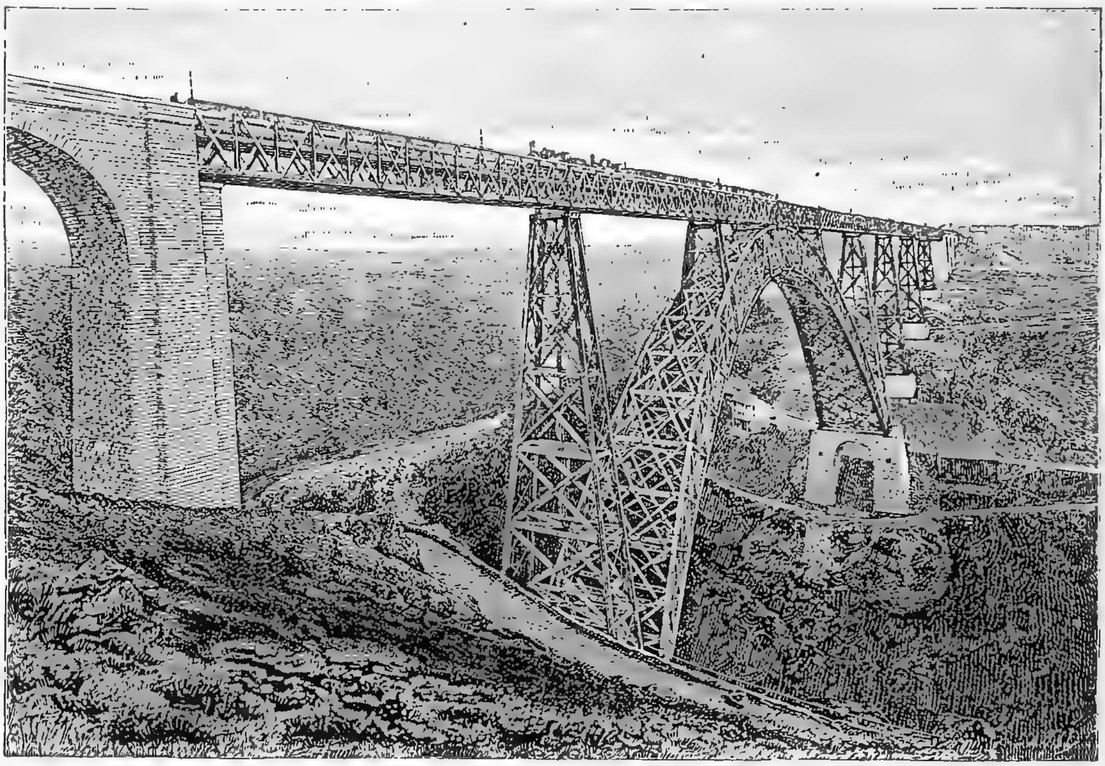


FIG. 4.—GENERAL VIEW OF THE VIADUCT OF GARABIT.

SOME RECENTLY DISCOVERED FORMS OF MICROSCOPIC CRUSTACEA.

ALTHOUGH it may with perfect truth be said that there is nothing new under the sun, it is no less true that there are many things which have hitherto escaped the ken of our senses both in the organic and inorganic worlds.

Even were it not so, and everything above and below the earth were known and tabulated, the zoologist, botanist, and geologist would still find endless occupation in studying the life history, histology, and composition of this multitudinous variety of life and matter spread out before us.

One has only to take up the study of any special branch, and he will first be astounded at his own ignorance, and then, as he perseveres and obtains some grasp of the labours of previous workers in his line of research, he will before long come to see that the air, earth, and sea have not yet yielded up all their storehouse of treasures, and that there is still room for original investigation in every branch of natural history.

In our own time a remarkable stimulus has been given to the study of biology, especially through the life and works of that greatest of naturalists, Charles Darwin; and with such a brilliant example before us of quiet, patient investigation, extending over so many fields of nature, we may well be encouraged to persevere in the study of any one special subject. The choice will depend upon the particular taste or environment of the individual.

To those of us who reside near the sea board, great opportunities are ready at hand—stones and rocks at low water being sure to furnish material from all the divisions of invertebrate life; and the possession of a boat and dredge will ensure the capture of forms unaffected by tides.

It is proposed in this paper briefly to describe and illustrate several species of minute marine crustacea which Mr. Isaac C. Thompson, F.L.S., has recently discovered, taken principally by means of the tow-net in the waters about our west coast.

They all belong to the *Copepoda*, an order of the *Entomostraca*, of the great class *Crustacea*, the *Copepoda* being probably the oldest and most degenerate members of the class.

They are not at all confined to salt water, many species being common in our ponds and lakes, of which the cyclops is perhaps the most familiar example. Indeed, it would be difficult to find a pool that does not contain it, and it is not an uncommon inmate of caraffes in country, and perhaps even in town, hotels. A copepoda is a somewhat pear-shaped animal, composed of from sixteen to twenty somites or segments, having two pairs of antennæ, known as anterior and posterior, three pairs of prehensile and masticatory or suctional mouth-organs, and five pairs of swimming feet. The carapace, or shell-covering, falls loosely over the limbs, the terminal portion of the animal being the abdomen, which is composed of from three to five segments. Attached to the latter

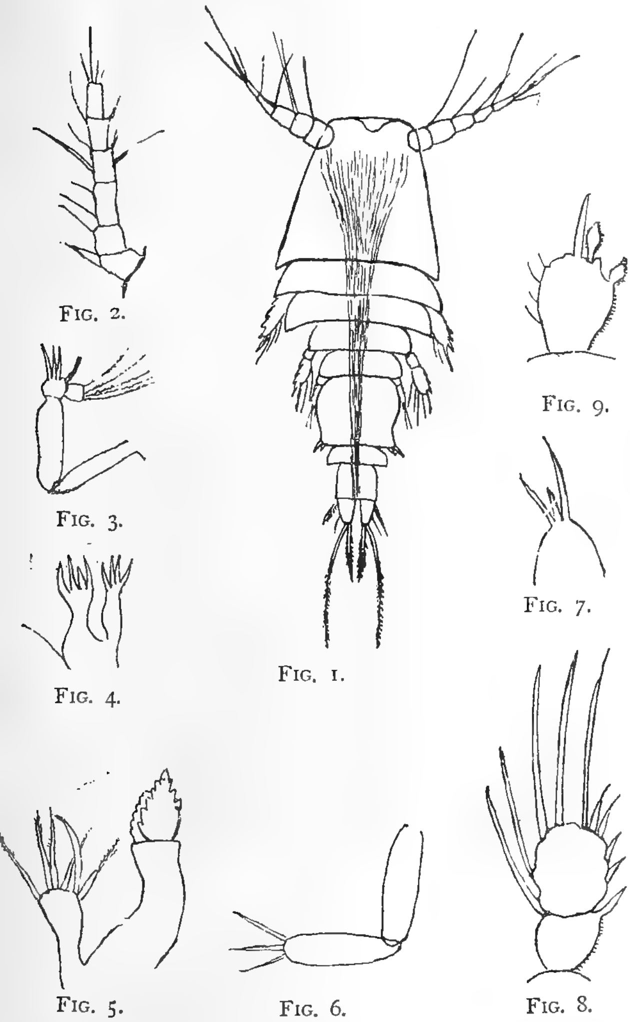


PLATE I.

CYCLOPS PUFFINI, I.C.T. (FIGS. 1-9).

Fig. 1. *Cyclops Puffini*, I.C.T., female, × 150 diams.
Fig. 2. Anterior antenna of do. 250 „
Fig. 3. Posterior antenna of do. 250 „
Fig. 4. Mandible of do. 400 „
Fig. 5. Maxilla of do. 400 „
Fig. 6. Anterior footjaw of do. 400 „
Fig. 7. Posterior footjaw of do. 400 „
Fig. 8. One of third pair swimming feet of do. 400 „
Fig. 9. One of fifth pair swimming feet of do. 400 „

the female often carries external sacs containing ova; the larvæ are immature when hatched, and go through several metamorphoses before arriving at the adult form.

The eyes in most species are situated in the frontal portion of the body, and generally appear as though one only; they are connected with the brain by nerves, and are imbedded in a mass of pigment.

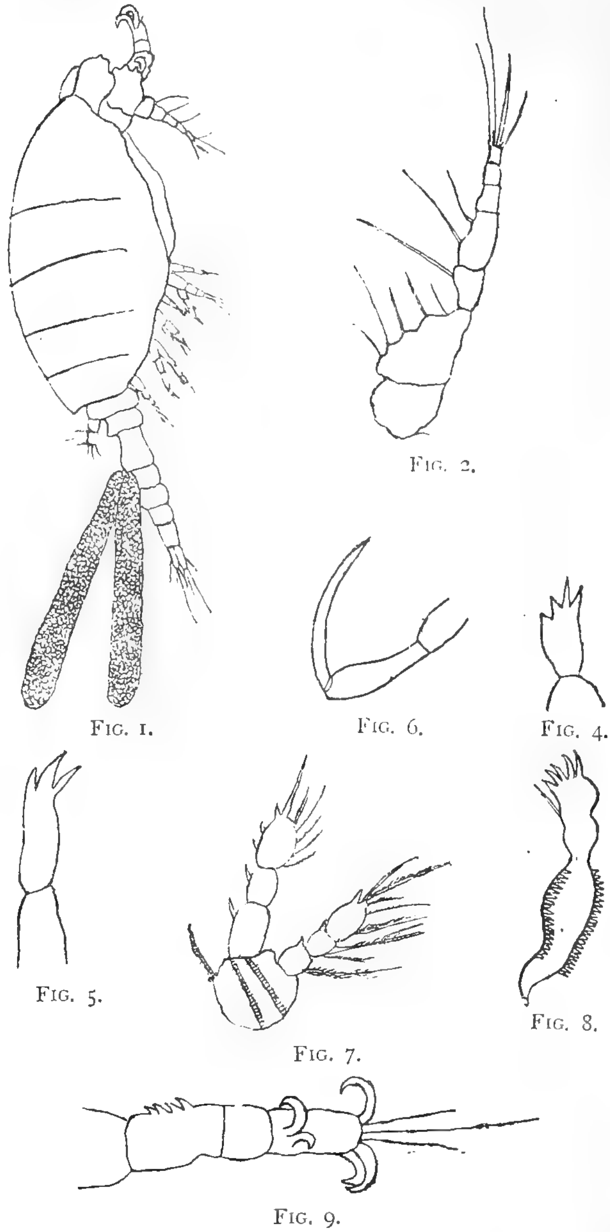


PLATE II.

LICHOMOLGUS SABELLÆ, I.C.T. (FIGS. 1-8.)

Fig. 1. *Lichomolgus Sabellæ*, I.C.T., female, × 150 diams.
Fig. 2. Anterior antenna of do. 250 „
Fig. 3. Posterior antenna of do. 250 „
Fig. 4. Anterior footjaw of do. 400 „
Fig. 5. Posterior footjaw of do. 400 „
Fig. 6. Posterior footjaw of male 400 „
Fig. 7. One of fourth pair of swimming feet 400 „
Fig. 8. One of fifth pair of do. 400 „

The anterior antennæ are used vigorously by the animal in propelling itself through the water; it is probable that they also contain organs of smell, as is known to be the case with ants and other insects. Copepoda abound everywhere in the ocean. In size they range from $\frac{1}{30}$ in. to nearly half an inch in length in one northern species, which is said to be the chief food of the Arctic whale, and gives a distinct red colour to the waters where it abounds.

They are very easily captured by means of a tow-net, a long, very fine muslin bag, with a round metal hoop about a foot in diameter, and narrowing in a length of about five feet to nearly a point. Attached to a long cord, the tow-net is pulled along from a boat, skimming the surface and occasionally being allowed to fall a few feet or more below. In about ten or fifteen minutes it is taken out, and the inside end floated into a wide-mouthed jar of clear water, which, on being held up to the light, will probably be found to contain minute creatures of brilliant colours darting vigorously about in all directions.

These are mainly copepoda, and it is a little remarkable that so comparatively small attention should have been given by naturalists to a class which forms by far the largest proportion of the life of our seas and oceans, and which are of the greatest service to mankind, for they are truly the scavengers of our lakes and seas, devouring refuse matter that would otherwise lead to pollution, and by turning the seeds of decay and death into vigorous life, again forming rich food for fishes and higher crustaceans, which, in their turn, furnish an illimitable quantity of food for man.

There are few more interesting or beautiful objects as seen under the microscope, and their variety gives scope for endless examination and careful study. They are very easily preserved in glycerine, or in a mixture of glycerine, alcohol, and water, and if put into such a solution soon after capture will retain their colours for a very long period, if not indefinitely. As microscopic slides they may without any further preparation be permanently mounted in glycerine jelly, and viewed with objectives varying from the one inch to the one-eighth inch power.

Cyclops Puffini, I.C.T. (Plate I.)—This elegant little species was first found near Puffin Island, at the mouth of the Menai Straits, being taken by a tow-net from the steamer *Gamecock* during the excursion of the British Association from Manchester last year. It is specially interesting to science as being the first species of the genus Cyclops ever found in salt water, thus forming a connecting-link between marine and fresh-water species. It is one-twentieth of an inch long. The anterior antennæ (fig. 2) are short, being six-jointed, and clothed with long whip-like setæ or hairs. The posterior antennæ (fig. 3) are terminated by several spines and plumose setæ. The mandible, or masticatory jaw (fig. 4), is divided at the apex into long sharp slender spinose teeth. The maxilla (fig. 5) is furnished with several plumose spines, the termination of the palp having a deeply serrated edge. Two of the swimming feet are represented in figs. 8 and 9. The abdomen (fig. 1) is three-jointed in both sexes, being terminated by caudal segments, with long plumose hairs at ends.

This Copepod was named after the Island, Puffin, around which it has been taken on several occasions during the late summer. A biological station has been recently opened upon this charming island, under the directorship of Professor Herdman, of Liverpool University College, and is being largely availed of by students and naturalists. Its situation for biological purposes is all that can be desired. It contains sleeping accommodation for six, and is fitted up with microscopes and all the other paraphernalia for biological investigation. The resident curator furnishes weekly returns of the work done, also particulars as to weather and other meteorological observations.

Lichomolgus Sabellæ, I.C.T. (plate ii.)—This striking Copepod was first taken at Beaumaris, North Wales, about a year ago, being found adherent to the tentacles of the sandworm Sabella, hence its name. It is somewhat strange that this species should not have been previously recorded, as numbers of specimens of the worm examined were all found to be similarly infected. It is of a greyish-brown colour. Both sexes were found on a single worm, the male being one-tenth of an inch long and the female one-fifteenth of an inch, the latter the most plentiful, and at once distinguished by its long, narrow ovisacs. The body is ovate, and the first segment nearly half the length of the cephalothorax. The rostrum is short and beak-like. The anterior antennæ (fig. 2) are alike in both sexes, composed of seven joints, the two basal joints large and strong and about equal in length to the other five; their edges are roundly serrated and curled over, with several setæ. The third joint has three long setæ on inner margin, and the terminal joint has several long setæ at apex. The posterior antenna (fig. 3) are also alike in both sexes, and have four joints; the second joint has four teeth placed longitudinally; the terminal joint has several hooked claws both at side and at apex, the latter having also several long setæ. The mandible is strongly toothed, the terminal portion having three spines. The maxilla has a long process terminated by a blunt spine, and bearing on each side a row of sharp teeth similar to those of the mandible; the other extremity has five digital spines.

The anterior footjaw (fig. 4) is two-jointed, the second joint terminated by four short spines. The posterior footjaw is also two-jointed; that of the male (fig. 6) being terminated by a long falciform claw, similar to that of *L. fucicolus*, Brady, and that of the female (fig. 5) is elongated and terminated by three claw-like spines. The swimming feet of the first four pairs are two-branched (fig. 7), each branch being three-jointed, and bearing several spines and plumose setæ. The fifth feet (fig. 8) in both sexes are composed of one short straight joint terminated by two spines. The abdomen is five-jointed in each sex; the first joint nearly equal in length to the remaining four, and much broader, especially in the male. The caudal segments are parallel, and about three times as long as broad, and are each terminated by four setæ, in addition to a small seta about the middle of the outer edge. The species can be easily recognised by its remarkable antennæ. Even after being preserved in alcohol, the crustaceans were tenaciously attached by their strong, broad-set antennæ to the tentacles of the sabella, some force being required to remove them without injury. It has within the last month been found on the same worm at Puffin Island.

(To be continued.)

Manchester Scientific Students' Association.—At a meeting held on November 20th Mr. Henry Hyde read a paper on "Comparative Respiration in Animals," illustrated with diagrams.

Edinburgh Geological Society.—At the anniversary meeting, held on November 22nd, Mr. Ralph Richardson, vice-president, delivered an address dealing with Darwin's geological work.

General Notes.

New Locality for "Boghead."—According to M. Martin, a genuine specimen of the Boghead mineral has been found in Eastern Siberia, in the Stanovoi mountains. The quantity of the find is not mentioned.

Leprosy in Russia.—According to the *Medical Press*, leprosy is becoming more prevalent in Russia, as several *foci* of infection have appeared in distinct parts of the empire.

Diamonds in Borneo.—It seems, according to *Cosmos*, that diamonds of the first water are being mined in Borneo. The locality is not stated, but it seems to be in that portion of the island under Dutch sovereignty.

The Polar Flattening of Neptune.—M. Tisserand, in a memoir presented to the Academy of Sciences, shows that the polar flattening of Nepture may be deduced from the movements of his satellite. The disc of the planet subtending only three seconds, a direct observation has not hitherto been possible.

A Probable Expression of Chemical Affinity as Mechanical Attraction.—Professor J. W. Langley of the Michigan University, suggests that chemical affinity may produce a direct attraction acting in right lines for greater distances than the radius of a molecule, and having a selective character.

The Height of Waves.—*Cosmos* mentions that waves off Cape Horn have been estimated at from fifteen to twenty yards in height, reckoning from the level of the sea. The height from the bottom of the trough to the crest of such a wave would, therefore, be from thirty to forty yards. These estimates, of course, lack precision.

Royal Institution.—The next course of Christmas Lectures adapted to a juvenile auditory will be given by Professor Dewar, F.R.S., the subject being "Clouds and Cloudland." They will begin on December 27. During the recess the staircases leading from the gallery of the theatre have been considerably altered in order to facilitate more speedy egress.

Geology of London.—Professor H. G. Seeley, F.R.S., is about to deliver a course of lectures on the practical study of the geology of the country round London. This course is given at the request of students of the London Geological Field Class, and information concerning them may be obtained from Mr. William Dunn, 21, King William Street, Strand, W.C.

Purification of Minerals by Electricity.—Quartz, china clays, and other minerals are often found unfit for use in pottery, glass-making, and other chemical arts, on account of the presence of oxide of iron. When such minerals exist in or are reduced to the state of powder, the iron can be removed by bringing them in contact with a series of powerful electro-magnets.

Magnetic Perturbations.—M. André (*Ciel et Terre*) remarks that from France to Tierra del Fuego magnetic perturbations are a general phenomenon, absolutely simultaneous over the whole earth, and taking place in all parts at the same moment. He attaches these perturbations to a cause not residing in the interior of the earth, but external, and to be sought for in the sun.

Detection of Strychnine.—Mr. Lovett communicates to the *Journal of Physiology* some observations on the "topography" of the action of strychnine. By experiments on that "martyr of science," the frog, he has found the greater part of the poison taken is to be found in the spinal cord, which contains more than the brain, liver, and muscles put together. Hence in chemico-legal investigations the spinal cord should be analysed in all cases where strychnine is suspected.

Human Diet in Prehistoric Ages.—M. Piette (*Comptes Rendus*) concludes, from his prolonged researches in the bone-caverns of the Pyrenees, that the so-called "Magdalean" age, which forms part of the Mesolithic epoch, was much more prolonged than it has been generally supposed. At its outset a great number of horses were eaten as food, but towards the end this custom seems to have disappeared, and to have been succeeded by the consumption of reindeer and other *Cervidæ*.

The Pasteur Institute.—The subscriptions for founding and endowing this institution reached the sum of 2,586,000 francs. There exist in the world twenty such establishments—seven in Russia, five in Italy, one in Austria, one in Spain, one at Bucharest, one at Rio de Janeiro, one at Havana, one at Buenos Ayres. Two more are in course of organisation—one at Chicago, and one in Malta. Such is the trouble man has to take to defend himself against "his most faithful friend the dog."

The Crops in Belgium.—According to *Ciel et Terre*, the crops for the last season have been almost universally deficient in Brabant. The yield of wheat and rye has been bad; barley is less universally defective, but the yield is below an average both in grain and straw. Oats have not been much injured, as it has also happened with peas, beans, and buckwheat. Colza and flax are bad. The yield of hay has been deficient, and it has been gathered in bad weather. Potatoes are attacked by disease, and the sugar-beet has produced more leaves than roots.

What is a Billion?—When this term was first devised by the Italian arithmeticians of the fourteenth century it was intended to mean the square of a million, or a million millions. In this sense the term is still used in Italy, Germany, and Britain. But in France men of business and schoolmasters have taken to give the name "billion" to a thousand millions, though astronomers and mathematicians retain the original notation. The United States have followed suit, either, as *Science* puts it, in order to be like the French or to be unlike the English, and we have thus a pretty piece of confusion.

Decomposition of Carbonic Acid Leaves under the Influence of Light.—Th. W. Engelmann (*Archives Néerlandaises*) has made a quantitative examination of the absorbent power of leaves of different colours, whereby it appears that chlorophyll consists of at least three different colouring matters. Yellow leaves of *Sambucus niger* decompose carbonic acid, though less energetically than green leaves. Another group of coloured leaves contains not chromophyll but cellular juice of a red colour. An influence of this colouration upon vitality could not be traced. The chlorophyll of such leaves is of the ordinary kind. The rays absorbable by chlorophyll pass nearly unaffected through the red cellular sap.

The Earthquake in Liguria.—M. Issel has communicated to the Academy of Sciences a full account of the damage occasioned in Liguria by the earthquake of 1887. The area shaken on February 23rd differs little from that agitated on February 23rd, 1818, September 9th, 1828, and May 26th, 1831. The number of persons killed in the province of Porto Maurizio was 597, and in that of Genoa 38. The wounded in the former were 474, and in the latter 81. The damage done to houses, etc., in the districts of Porto Maurizio and San Remo is estimated at more than thirteen million francs, and in the province of Genoa 2,281,000 francs.

The Ancient Greek Alchemists.—Professor Berthelot has just laid before the Academy of Sciences the completion of the publication of these treatises, accompanied by translation. The fifth part of the work is the most interesting, containing not mystical reveries and imaginings, but positive processes and definite results. It comprises a series of memoirs on tempering and colouring metals, especially bronze and iron, the moulding of bronze, the gilding of iron, the colouration of imitation precious stones, the treatment of pearls, the manufacture of potash from wood-ashes, that of beer and soap. Most of these tracts seem to be drawn from a great Byzantine manual of industrial chemistry, compiled in the 8th or 9th century. But some of the portions date back to an earlier epoch.

A New Proof of the Earth's Rotundity.—It is now some years since M. Ch. Dufour pointed out, from theoretical considerations, that, since the surface of water in large bulk is really spherical, with a curvature corresponding to that of the earth, the image of the sun reflected from it must really have an elliptical form. In 1886, Signor Ricco commenced some still uncompleted observations on the solar reflection from the marine horizon, as seen from the Palermo observatory; he has found the obliquity of the sun's image very marked in clear and calm weather. M. C. Wolf has applied the same principle to the distortion of star images; this, with the results just announced by M. F. A. Torel for the eccentricity of the solar image after reflection from the Lake of Geneva, shows that it is no longer simply theory, but a new direct experimental proof, that the earth is round.

Electric Storms.—Professor Müller, of the Russian Lyceum of Tashkend, describes (*La Nature*) a storm which took place in and near that town on July 29th, and lasted for three hours. Amidst dense clouds, which quite obscured the daylight, the lightnings crossed each other without interruption, and the thunder roared, but there fell all the time not a drop of rain. The air, however, was sensibly cooled and purified. On the next day a friend of Professor Müller was walking along the flanks of the wooded mountains near Vladikavkas, at about six p.m., when he heard a dull sound which gradually increased. He stopped, and saw below him a group of fire-balls which were moving slowly in the direction of the valley. He distinguished clearly three such balls; that in the centre, apparently of two feet in diameter, was yellow with golden reflections. At its sides there were two others of a splendid purple colour. The phenomenon lasted for three minutes.

Interesting Discovery.—Lieutenant D. Bruun, of the Danish army, having had a moss dug out in Finderup, in Jutland, has made some interesting discoveries. In the moss were found trunks of oak, beech, and fir trees, from 6 to 30 inches in diameter. The branches had in some cases been cut off, but the bark remained. By the side of one of the oak trunks two earthen vessels were discovered, and near another a third shaped like an urn. In the latter lay a sandal cut from a piece of leather, with flaps, and leather straps for tying to the ankle, the length of the sandal being 7 inches. It seemed as if the trunks of trees had been placed in a certain position for some purpose or another. About 20 feet farther to the south, and at the same depth, viz., 6 feet, a yoke of oak was found, $5\frac{1}{8}$ feet long and 3 inches thick, being fairly cylindrically cut out in the centre. At each end were holes, in one of which remained a strap of leather. Other implements of oak were also found, evidently used for carrying. Some of them seemed part of a wheel. Close to the yoke another earthen urn was discovered, which, like the three referred to, was surrounded with sprigs of heather and bramble. Formerly some horns of bullocks and the skeleton of a man in a fur coating were found in the moss. The various objects are now in the Copenhagen Museum, and are said to date from the early iron age.

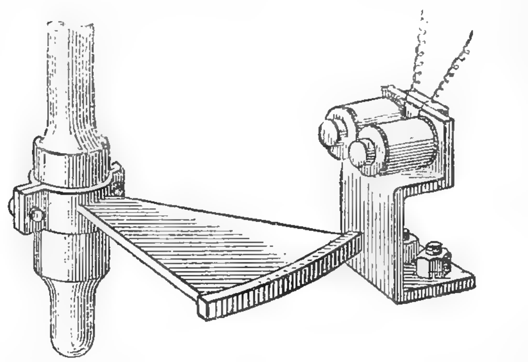
The Public Health.—The Registrar-General's return for the week ending November 24th shows that the deaths registered during that period in 28 great towns of England and Wales corresponded to an annual rate of 18·2 per 1,000 of their aggregate population, which is estimated at 9,398,273 persons in the middle of this year. The six healthiest places were Derby, Hull, Leicester, Birmingham, Wolverhampton, and Sheffield. In London 2,722 births and 1,409 deaths were registered. Allowance made for increase of population, the births exceeded by 12, while the deaths were 370 below, the average numbers in the corresponding weeks of the last ten years. The annual death-rate per 1,000 from all causes, which had been 19·7, 18·5, and 19.7 in the preceding three weeks, fell last week to 17·2. During the first eight weeks of the current quarter the death-rate averaged 18·9 per 1,000, and was 1·0 below the mean rate in the corresponding periods of the ten years 1878-87. The 1,409 deaths included 133 from measles, 20 from scarlet fever, 41 from diphtheria, 19 from whooping-cough, one from typhus, 15 from enteric fever, 1 from an ill-defined form of continued fever, 18 from diarrhœa and dysentery, and not one from small-pox or cholera; thus, 248 deaths were referred to these diseases, being 27 above the corrected average weekly number. In Greater London 3,536 births and 1,756 deaths were registered, corresponding to annual rates of 33·3 and 10·6 per 1,000 of the estimated population. In the Outer Ring 29 deaths from measles, 6 from diphtheria, 4 from whooping-cough, 3 from "fever," and 3 from scarlet fever were registered. Fifteen fatal cases of measles occurred in West Ham, 4 in Tottenham, and 2 in Sunbury sub-districts; 2 deaths from diphtheria were recorded in Godstone, and 2 from whooping-cough in Tottenham sub-districts.

RECENT ASTRONOMICAL WORK AT THE LICK OBSERVATORY.

THE Lick Observatory was transferred to the Regents of the University of California on June 1st, 1888, and has, therefore, been in active operation as a State institution for about four months, and much of this time has been devoted by the astronomers to studying the instruments under their charge, and determining the constants necessary for future work, the great telescope naturally claiming the largest share of attention; but many observations of important phenomena have been made, and the objects of greatest interest in the sky have been carefully examined with a view to the discovery of new features, as well as for the purpose of testing the performance of the lens. The sun has not yet been observed with the great telescope, but it is doubtful whether any advantage can be gained here in the study of his surface by the use of a large instrument. The seeing on Mt. Hamilton is usually poor in the daytime, owing probably to the heated air of the surrounding valleys, which is rapidly cooled at night by radiation or shut in by the fogs which then pour in from the ocean.

Mercury and Venus have been seen in the daytime only, and, therefore, under the same disadvantageous circumstances. There are, however, days of good seeing, when the features of these planets can be profitably studied. The moon is a most beautiful and interesting object with the great telescope. It was photographed throughout an entire lunation in August, and the pictures then obtained are a distinct advance on all previous work in this direction. The diameter of the lunar image on the negatives is five and a quarter inches, and with the plates used the exposure required was a little less than half a second. Observations were made with the various instruments during the total lunar eclipse of July 22nd, and will be published in the memoirs of the National Academy of Sciences. Mars had become too low in the west after the transfer of the Observatory to be well seen. Numerous drawings were, nevertheless, made by Professor Holden, Mr. Schaeberle, and Mr. Keller, and published in the *Astronomical Journal*. The principal canals of Schiaparelli were seen, not as double, but as single, ill-defined lines; and the continent of Libya, which, according to M. Perrotin, had been submerged or did not exist during April and May, appears on the drawings in its usual shape and position. The micrometer observations of the satellites made by myself when the planet was in opposition have been published in the *Astronomical Journal*. The satellites, which appear to have been seen with great difficulty elsewhere, were bright and easy objects with the 36-inch equatorial—a fact which affords gratifying testimony as to the instrument, and the excellence of the atmospheric conditions. Phobos was seen on July 18th, when its brightness was only 0·22 of that at mean opposition, and one-eighth of that at the time of discovery by Professor Hall. From the ease with which this satellite was seen in close proximity to the planet, it seems to me probable that we can observe eclipses during favourable oppositions, and determine the mean motions of the satellites with greater accuracy than is obtainable by micrometer observations.

Jupiter was frequently examined on fine nights in June and July. His surface showed a wealth of delicate detail which would have required a much longer time to record satisfactorily than it was possible to give. A number of observations were made of curious appearances presented by the shadows of satellites in transit. The satellites themselves appear as large and well-defined discs. Saturn has not been observed since the telescope was first mounted in January. It was then a splendid object, all the wonderful details of the system shining with a brilliancy and distinctness probably never before equalled. The outlines of the rings were sharp and clear, and a fine, dark line was seen close to the outer edge of the outer ring, with a dark shading extending inward toward the great black division. The gauze ring was very conspicuous. Neptune has been observed by Professor Holden and Mr. Schaeberle, and (with its satellite) has been photographed several times. Many double stars have been discovered and measured by Mr. Burnham with the 36-inch and 12-inch equatorials. Perhaps the most interesting of this class of objects discovered with the aid of the large telescope is the star ρῦ (Gamma) γ Cassiopeæ, which is found to have a minute companion distant 2·2″, in position angle 256°. It has been frequently observed lately with the 12-inch equatorial. Difficult stars, previously known, have also been measured by Mr. Burnham. The planetary nebulæ have been studied by Professor Holden and Mr. Schaeberle, who have observed in several of these objects curious helical forms, which do not appear in earlier



ELECTRIC CONTROL OF THE CLOCK OF THE GREAT TELESCOPE.

drawings with smaller instruments. The ring nebula in Lyra is a wonderful object in the great telescope. The central star, discovered by Von Hahn, is very conspicuous, and four other stars of exceeding minuteness appear within the limits of the inner ellipse, while a star, almost as bright as the one in the centre, is seen exactly at the proceeding extremity of the major axis of the ring. Many other small stars not so critically situated, and therefore less interesting, are seen in proximity to the nebula. These minute stars are beyond the range of all but the most powerful telescopes, although it may be noted that there is a class of observers with very small telescopes prepared to immediately "verify" all discoveries made by powerful instruments, even when, as has sometimes been the case, the supposed discoveries are afterward found to be purely fictitious. There is no way of disproving that a difficult object can be seen by such an observer with an apparently inadequate instrument, or of showing that excess of zeal is made to take the place of sufficient optical power. Mere size, it is true, unaccompanied by other qualities, counts for but little, and the greater part of astronomical work has been done by skilled observers with instruments of moderate dimensions. To many persons the cost and difficulty of construction of great telescopes seems out of proportion to the optical advantage gained, but the same thing is seen in other departments of astronomy, as well as outside of the science. A sextant, with which the places of the stars can be determined to within a fraction of a minute of arc, costs less than a hundred dollars, while thousands must be expended if fractions of seconds are to be taken into account, the error of position in either case being beyond detection with the unassisted eye. The 12-inch telescope has been used by Mr. Barnard for the observation of comets and nebulæ. It has been found by him to be capable of giving photographic images of exquisite sharpness, and in this capacity forms an important addition to the outfit of the Observatory. Twenty-five new nebulæ have been discovered by Mr. Barnard with this telescope, and a comet (comet *e*, 1888) was discovered by the same observer with the 4-inch comet seeker, on September 2nd. It is probable that the 12-inch telescope will be fitted with a new driving clock, in order to better fit it for photographic work. No change has been made in the dome and hydraulic elevating floor of the large telescope. The convenience, and indeed necessity, of the elevating floor is every day more apparent. The rapid motion of the eye end of the telescope (a foot in eight minutes for an equatorial star) would alone make the use of an observing ladder proportioned to the size of the instrument, extremely troublesome. The pier, when finally placed in exact position, will probably be filled with brick and sand. The driving clock of the large telescope was provided by the makers with an electric control for keeping its rate in exact coincidence with that of a standard astronomical clock. The vertical shaft of the governor rotates in one second, and has near the bottom a small projecting pin. A stud on the armature lever of an electro-magnet is struck by the pin as the governor shaft rotates, when a current is passing through the magnet, but when the current is broken once a second by a standard clock, the stud is withdrawn at the proper instant to allow the pin to pass. There is also an ingenious and beautifully constructed attachment for breaking the circuit in case the standard clock should, either by accident or design, omit one or more seconds in a minute. The driving clock is adjusted to run a little fast, and is continually checked by the control, the governor being allowed to rotate by turning on a friction collar. It was found, however, that the impact of the pin on the governor shaft against the stud of the armature caused a shock which was transmitted to the telescope, and produced a disturbance of the image fatal to photographic work. The control was therefore removed, and another which Mr. Keller devised for the purpose of giving a perfectly smooth motion, was substituted for it. The new control answers its purpose so well, and is of such extreme simplicity, that we shall give a description of it here, as it can be applied to any clockwork having a shaft which rotates in an integral part of a second. A soft iron sector, subtending an angle of 36°, and having a radius of six inches, is clamped to the vertical axis of the governor, and rotates in a horizontal plane. The sector passes very close to the poles of an electro-magnet (part of the old control) which is mounted on a slightly elastic standard of steel. At every second a strong current is sent through the coils of this magnet, by means of a standard clock, the circuit being closed, as in the case of the old control, by the relay points of the chronograph attached to the driving clock. The driving clock is set so as to run a little too fast, and when the governor is started the sector gradually gains upon the click of the chronograph until it reaches the magnet of the control, when the friction produced by the attraction of the latter prevents any further acceleration, and the governor will rotate in exactly one second by the standard clock, as long as the control is in operation.

The elasticity of the support on which the electro-magnet is mounted plays an important part in the proper working of the control. When the sector passes at the exact instant of the passage of the current, the magnet springs in toward the sector, and comes into actual contact with it, very greatly increasing the friction, while the passage of the sector at any other instant meets with no resistance, the magnet being slightly withdrawn by its support. The current used [illegible] ntrol is obtained from the battery of twen[illegible] employed during the daytime in transmitting time signals to San Jose. As the signals are not sent at night, the battery is then connected with the control by turning a switch. With this control no shock is communicated to the telescope; and the image of a star is steady. Since, however, changes of refraction and slight irregularities in the clockwork produced small displacements of the image in a telescope, it has always been necessary in photographing with long exposures to keep the telescope pointed by hand, correcting any displacement which may occur by the slow motions of the instrument. It was found impracticable to move the immense mass of the Lick telescope with the quickness and delicacy required in this operation, and after various experiments, Mr. Schaeberle suggested that the photographic plate should be mounted upon double slides, one moving in right ascension, and the other in declination, and should be kept upon a star by means of a diagonal microscope attached to the plate. A rough experimental model was constructed on this plan by the observatory machinist, and performed so satisfactorily that a plate holder of more accurate workmanship will be made on the same principle. The public receptions on Saturday evenings interfere greatly with these experiments, as all apparatus must then be removed to fit the telescope for visual observation. Probably few visitors are aware of the hindrance to astronomical work caused by their entertainment, although, as a duty to the public the sacrifice is always cheerfully made. Many fine nights are to be expected during the months of October and November, but after that, fog and rain will almost put an end to observation until the succeeding spring.

Wolverhampton Literary and Scientific Society.—On November 20th Mr. Harold B. Dixon, F.R.S., delivered a lecture on "The Nature of Explosions," before this society. Mr. Dixon demonstrated the different kinds of explosion produced by gases, gunpowder, and gun-cotton. He referred to the difference in the mechanical means by which the oxygen and the combustible body come together, and said that explosions, according to two distinguished French chemists, could be divided into three parts—the ordinary combustion, the intermediate period of vibration, and the period of detonation. Reference was made to the measurements of the explosions of gases, and the conclusions arrived at under this head, together with illustrations of the amount of pressure produced in instantaneous explosions.

Natural History.

GROUSE.

HARDLY any wild birds are so familiar as the grouse, and no others equal them in economic value. These are surely good reasons for a glance at their natural history, which will be found to lead to questions of some theoretic interest.

Four species of grouse occur in the British Islands. Two belong to the genus *Tetrao* of modern systematists, and two to *Lagopus*. The red grouse (*L. Scoticus*) inhabits Scotland, North England, Wales, and Ireland; the ptarmigan (*L. alpinus*) is found in Scotland only; the black cock (*T. tetrix*), whose female is the grey hen, occurs in parts of England, Wales, and Scotland; while

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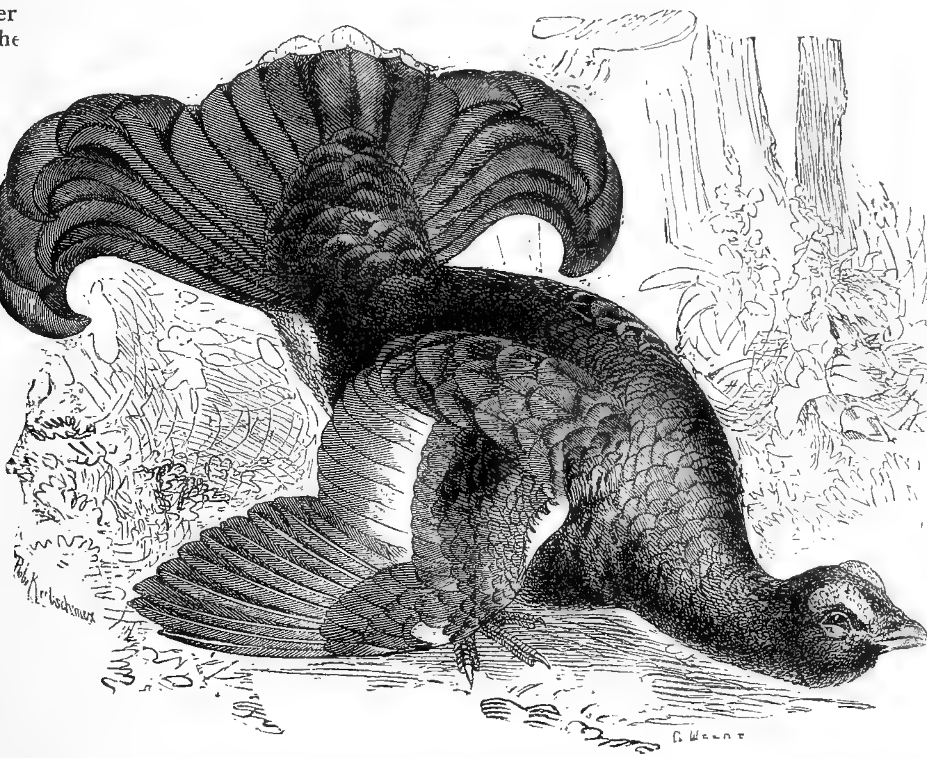


BLACK COCK (*Lagopus tetrix*).

the capercaillie (*T. urogallus*), formerly native to Scotland and Ireland, after becoming completely extinct in both countries, was reintroduced some fifty years ago from Sweden to Taymouth, where it continues to flourish and gain ground. Scotland, it will be observed, enjoys all four of these valuable birds, England possesses two, and Ireland one.

Three of the species found here have a considerable foreign range in northern or Alpine regions, but the red grouse, alone among birds, is peculiar to our islands. Quite recently its range has been artificially extended by Oscar Dickson, who has succeeded in establishing a colony at Gottenburg, in Sweden, but the ultimate result of this experiment is still to be waited for.

Our rude English nomenclature ignores all natural affinity, and even etymology. *Grouse*, in some old writings spelt *grice*, is perhaps "brown" (Fr. *gris*). *Ptarmigan* is believed to be the Gaelic *tarmachan*, and was formerly written *termagant*. The initial *p* is entirely superfluous, having been added, like the *n* in *newt*, the *s* of *scratch*, and the *d* of *thunder*, in the days when every man spelt as he thought emphasis required. A convenient English phraseology would be attained if we could use the descriptive epithets of red, snow, heath, and wood grouse, to denote the red grouse, the ptarmigan, the black cock, and the capercaillie respectively, but the innovation is perhaps too bold to be entertained.

The most obvious peculiarity of the grouse is the feathered feet, which distinguish them from their nearest allies the partridges, and if we consider native species only, this is a sufficient mark. Grouse are rough-footed, gallinaceous birds. Of internal peculiarities, the most curious is the enormous length of the cæca of the large intestine. If we examine the beginning of the large intestine of a pigeon, we find a pair of little sacs about a quarter-inch long; in the fowl they are about four inches long, and dilated at the ends; in the red grouse each is a yard long, and its inter- surface is greatly extended by eight longitudinal folds. These appendages are filled with a sort of chyme, extracted from the food by the aid of the digestive juices, and their relative size appears to bear some relation to the nutritive value of the food. Where a given bulk of the ordinary food of the species yields a small amount of nourishment, as is the case with the heather-buds upon which the grouse feeds, the cæca are, as we have seen, of enormous length.

Grouse of the genus *Lagopus* usually change their plumage towards winter. The mottled brown of summer gives place to grey, and this to snowy white. As spring comes on the birds resume the summer plumage, which is also their wedding dress. In the ptarmigan this change is effected by a triple moult, which is not only unusual in its frequency, but also unusually complete. In other birds the second moult, where it occurs at all, is partial, a small proportion of the feathers being affected, or some part only of each feather being discarded. In the ptarmigan, however, the change is extensive, and concerns nearly all the feathers except the quills of the wing and tail, which are changed only at long intervals. Few adaptations are more familiar or more striking than this seasonal change, which brings about in regular succession a protective resemblance to the brown heather, to the thinly strewn snow, and lastly to the dense snow of a northern mountain. The only *Lagopus* which undergoes no corresponding change is our own red grouse, a species which would be rendered fatally conspicuous by turning white in winter.

Those of us who remember the days when the "Origin of Species" appeared will recollect how much was said about that time of the one bird peculiar to the British Isles. Owen, in the British Association Address for 1858 (which appeared a few weeks after Darwin and Wallace's preliminary papers), made this fact the text of an interesting though inconclusive discussion, which is now of some historical interest. It marks that change in scientific thought which for the first time forbade men to entertain seriously any such explanation as that the red grouse had been called into existence by a special creative act in and for the British Isles alone. Various writers have referred to a supposed former Continental range of the red grouse, for which bones found in caves and similar remains have been adduced as proof. We are very sceptical as to such identifications, for to distinguish the bones of our native species from those of the Continental willow-grouse would baffle the acutest anatomist. The history of the genus *Lagopus*, so far as it can be unravelled without light from fossil remains, may be conjecturally restored somewhat as follows: The common ancestor probably resembled in many respects grouse of the genus *Tetrao*, particularly in not turning white before winter. Our red grouse, by reason of its southern habitat, alone preserves this presumed ancestral peculiarity, and is so far the best surviving representative of the hypothetical common ancestor. Other forms, more or less northerly in range, have developed in a marked degree the seasonal change of plumage. Of these the willow-grouse is most nearly related to our own red grouse, while the ptarmigan, and the closely allied species which inhabit Spitzbergen and Arctic America, are more specialised forms, in which the winter changes are extraordinarily marked.

The combats for the possession of the females for which the game-cock is so notorious are exemplified in a yet more amusing form by the love-fights of the black cock and the capercaillie. The cocks assemble at well-known spots, where during weeks together they display their charms before the assembled females. The black cock struts, and dances, and beats his wings, and turns round and round in an excitement which at length becomes perfectly frantic. So absorbed are the birds that one after another may be shot, or even caught by the hand, without disturbing the others. When these antics are over the birds begin to fight, and eye-witnesses tell us that the snow may be seen all bloody on the battle-fields of the capercaillie, and that the black cocks make the feathers fly in all directions. In our Scottish pine-woods the excitement seldom reaches such a pitch, perhaps because crowds of birds cannot easily be gathered together, but the capercaillie, or cock of the woods, may often be found perched on the top of a high tree, and defying the universe by means of ludicrous noises and gestures, while the awe-struck females wait in silence the result of the engagement which usually ensues.

Abstracts of Papers, Lectures, etc.

THE INSTITUTION OF CIVIL ENGINEERS.

At the meeting on Tuesday, the 27th of November, the President, Sir George B. Bruce, being in the chair, a paper on "The Witham New-Outfall Channel and Improvement Works" was read by Mr. J. Evelyn Williams, M. Inst. C.E.

The author stated that in 1878 he was instructed, by the Witham General Commissioners, to report upon the improvement of the river Witham. He then found the Outfall, or tidal portion of the river, most unfavourable, both for drainage and for navigation. A tide which rose 21 ft. in Clayhole, in the estuary of the Wash, only rose 12 ft. 6 ins. at Boston. The lower reach of the channel, between Hobhole Sluice and the estuary, was not only shallow and circuitous, but untrained and broken through a mass of shifting sands. The flood-waters rushing seaward cut frequent and successive "steeps," from 10 to 12 ft. in height, which kept tumbling into the channel and choking it up; the channel thus became distorted, and sometimes shifted a mile from east to west in a few weeks. The flood-tide, from the estuary, swept over these shifting sands, and flowed like a rapid wave up the river to Boston, carrying a large quantity of sand in suspension. This was deposited during slack-tide in the upper reach of the outfall, where in dry seasons, during the absence of the fresh-water scour, the deposit reached the level of 11 ft. 6 ins. above the sills of the Grand Sluice in Boston, and rendered the flow of neap-tides insensible at the sluice. Ultimately it was decided to make a new outfall, and this paper consists of a detailed description of the work, but it is too technical for our columns.

PHYSICAL SOCIETY.

On November 24th, Professor Reinold, President, in the chair, Captain Abney read a paper "On the Measurement of the Luminosity of Coloured Surfaces," which was illustrated by experiments. In a communication to the Royal Society General Festing and the author have described a method of comparing the intensity of the light of different parts of the spectrum, reflected by various pigments, with that reflected from white; and luminosity curves have been constructed, the areas of which give comparative measures of the total luminosities. This method of comparison is accurate, but requires considerable time, and the author has devised a more rapid process. The coloured surface whose luminosity is to be compared with white is placed beside a white patch within a dark box. A direct beam of light passes through an aperture in the box, and a black rod casts a shadow on the coloured patch; another beam from the same source is reflected at an angle, and forms a shadow of the same rod on the white patch, the junction of the two shadows coinciding with that of the two surfaces to be compared. In the path of the direct beam is placed a rotating disc with angular openings, adjustable whilst rotating by a simple lever, and by this means the white patch can be made to appear too light and too dark in rapid succession. By gradually diminishing the range of oscillation of the lever, a position of equal luminosities can be found. The coloured surface is now replaced by a white one, and the adjustment again made; and from the angular apertures required in the two cases the relative luminosities are determined.

Comparisons made in this way (the numbers relating to which are given in the paper) with emerald-green, vermilion, French ultramarine, etc., gave results in close agreement with those deduced from the luminosity curves obtained by the spectrum method.

In reply to questions, Captain Abney said the spectrum method was the more accurate, and could be relied on to 1 per cent. The new method gave results within 2 per cent., showing that the eye is very sensitive to small changes of luminosity when such changes take place in rapid succession.

Professor Rücker made a communication "On the Suppressed Dimensions of Physical Quantities."

Professor Carey Foster, after discussing the effects of defining specific heat as a ratio, or as a quantity of heat on the dimensions of temperature, pointed out that as quantity of heat = temperature × entropy, the dimensions of temperature would be determinate if those of entropy were found.

Professor S. P. Thompson considered part of the difficulties of dimensional equation arose from the fact that no distinction was made between *scalar* and *vector* quantities.

ZOOLOGICAL SOCIETY OF LONDON.

At the meeting held on November 20th, Professor Flower, C.B, LL.D., F.R.S., President, in the chair, the Secretary read a report on the additions that had been made to the Society's Menagerie during the months of June, July, August, September, and October, 1888, and called attention to the acquisition of three specimens of Pallas's Sand-Grouse (*Syrrhaptes paradoxus*), captured out of the many flocks of this Asiatic bird that have lately visited the British Islands. A letter was read from Professor J. B. Steere, C.M.Z.S., giving a preliminary account of the "*Tamaron*," a Bovine animal found in the Island of Mindoro, Philippines, which he believed to be allied to the Anoa of Celebes. Mr. Edgar Thurston, C.M.Z.S., exhibited and made remarks upon a collection of corals from the Gulf of Manar, Madras Presidency. Mr. H. Seebohm exhibited and made remarks on a specimen of a new species of pheasant (*Phasianus tarimensis*), obtained by General Prejevalsky at Lob Nor, Central Asia. Mr. H. Seebohm also exhibited a specimen of a species of plover new to the British Islands (*Vanellus gregarius*), which had been shot in Lancashire about 25 years ago, and had been previously supposed to be a cream-coloured courser. Mr. J. W. Hulke, F.R.S., F.Z.S., read a paper on the "Skeletal Anatomy of the Mesosuchian Crocodiles, based on fossil remains from the clays near Peterborough, in the collection of A. Leids, Esq., of Eyebury." The author remarked that within the primary divisions of the order the definition of species had, as Strauch had remarked twenty years ago in his excellent "Synopsis of Extant Crocodiles," ever been one of the more difficult tasks of the systematic herpetologist. This he attributed largely to the mutability of the characters, chiefly external, employed; but principally to the inadequacy of the osteological material then available for the purpose. This latter want was at the present time scarcely less than when Strauch wrote, yet an exact and comprehensive acquaintance with the anatomy of the Mesosuchia must constitute the only secure and enduring basis of classification. In treating of extinct forms the difficulty was much increased. The collection of Mr. Leids contained a large series of crocodilian remains from the Oxford Clay in admirable preservation, which illustrated many anatomical details not to be learned from the skeletons embedded in slabs of rock contained in public museums. The author described a selection of bones from Mr. Leids's collection illustrative of the two chief families into which Messrs. Deslongchamps (père et fils) had divided the Teleosauria. The skeletal differences of the Teleosauria proper, and Metriorhynchi, and those existing between both these and the Eusuchian skeleton were pointed out; and the morphology of certain bones was discussed. Mr. Oldfield Thomas, F.Z.S., read a paper on a "Collection of Small Mammals obtained by Mr. William Taylor in Duval County, South Texas." The collection contained examples of one new species and one new geographical variety, besides adding no less than six species to the National Collection of Mammalia. A communication was read from M. L. Taczanowski, C.M.Z.S., containing a "supplementary list of the birds collected in Corea by Mr. Jean Kalinowski."

EDINBURGH ROYAL PHYSICAL SOCIETY.

At the meeting on November 21st, Dr. Sims Woodhead, F.R.S.E., Vice-President, in the chair, the Secretary, Dr. Traquair, F.R.S., submitted a paper "On the Structure of *Pterichthys* and its Allies," comparing it with the genera of *Asterolepis* and *Borthriolepis*. After remarking that some geologists have denied that *Pterichthys* was a fish, he went on by the aid of numerous specimens and casts to describe the more salient structural arrangement. Regarding the curious shield on the top of the head, he was inclined to believe it to have been a guard for the eyes, which, by an arrangement of muscles, could be raised or lowered at will. In a second paper "On *Homosteus*, Asmuss (Hugh Miller's *Asterolepis* of Sromness)," Dr. Traquair agreed with the Continental authorities that it must be classed as a *Pterichthyan* fish, and exhibited a beautiful cast of an exceedingly fine specimen. Mr. Harvie-Brown submitted a paper "On the Seal in Fresh Water," in which the occurrence of the seal in Loch Awe, first noticed in the Old Statistical Account, 1793, was traced down to the present time. It had been supposed at one time that the seal had made its way up the rapid river Awe in pursuit of salmon, but the opinion now held pointed to their presence in the loch as being due to physical changes. In the course of a discussion which followed, it was pointed out that Dr. John Murray's recent discovery of organisms in the locks of the west coast, which are not found anywhere else within the 100-fathom line, went far to support the theory of geological changes imprisoning animals in what might be considered quite unsuitable localities, but to which they had adapted themselves. In this way it was quite possible that the seals of Loch Awe had lived there from generation to generation. The physical features of the surrounding district were also remarked upon as showing evidence of late geological changes. Mr. George Brook, F.L.S., read a short note on a "roller" lately shot in Mull by Mr.

McLean, of Lochbuey, and business was concluded by the exhibition of a skeleton of the Great Auk (*Alca impennis*) by the Secretary.

GLASGOW NATURAL HISTORY SOCIETY.

On November 13th Professor Cossar Ewart delivered a lecture, under the auspices of this Society, on the Electric Organs of Fishes.

Professor Cossar Ewart said there were few if any structures in the whole realm of nature which, in addition to perplexing and puzzling the naturalist, had attracted more general attention than the electric organs of fishes. Aristotle seemed to have pondered long the peculiar force by which the electric ray numbed the fishes that came within its reach, and Darwin, after long and careful consideration, came to the conclusion that the electric organs offered a special difficulty to his theory of natural selection. And although, as the result of numerous investigations, a considerable increase had recently been made to our knowledge of these organs, it was still impossible to account for their origin, in some cases to offer an opinion as to their function, or even to say whether they were progressive structures or mere useless vestiges. Proceeding, the lecturer showed how the torpedo and other electric fishes fascinated the Greeks and to a less extent the Romans, and how they held their ground during the dark ages. One of the most noteworthy facts about electric organs, he went on to say, was that they were only found among fishes, and that although there were hundreds of different kinds of fishes there were practically only three kinds that were known to have electric batteries sufficiently powerful to be of any evident use. These were malapterurus of the Nile and other African rivers, the gymnotus of South America, and the torpedo found at times in our own waters and in considerable numbers in the Mediterranean and the Atlantic. Of the others in which electric organs were known to exist were the once sacred oxyrhynchus of the Nile, and the skates and rays which abound round the coast of Scotland. The malapterurus was a quaint-looking fish, with a fatty dorsal fin like the salmon, and six long barbules around the snout. It was said sometimes to reach a length of four feet. In this fish the electric battery was in the form of a continuous subcutaneous jacket or tunic, which invested the whole body, with the exception of the head and fins. It consisted of a countless number of minute cells from which electricity was thrown off at will. The gymnotus was a soft-skinned, sluggish creature, with small, stupid-looking eyes flattened back, and long ventral fin. It sometimes reached a length of six feet, and as the electric batteries occupied nearly two-thirds of the entire fish, one could easily understand how much it was dreaded by the natives of the Orinoco region, and how ordinary fishes gave the electric eel a wide berth. The gymnotus had four batteries—two large and two small—on each side of the body, supplied by about 200 pairs of nerves. The batteries were so powerful that a shock from a large, active fish was strong enough to strike down a man and numb away his consciousness for several hours. The torpedo was of special interest, because we were beginning to understand all the steps through which its organ had passed during its long and gradual evolution. Some of the species attained a great size. There was one, the giant torpedo, over four feet in length, which when cast ashore at Cape Cod, was said often by its unexpected shocks to strike down the unwary fishermen when they attacked it with their harpoons and boathooks. The shock of the common British torpedo was sufficiently strong to kill a duck, and when the organ was connected with a telephone the discharges first produced a croaking sound, but as the fish got excited each discharge was accompanied by a pronounced groan. The electricity discharged from the torpedo's batteries behaved like ordinary electricity, rendering the needle magnetic and emitting sparks, and it might even be used in charging a Leyden jar. But it should be specially noted that the living battery of fishes differed from the ordinary batteries. A Leyden jar or a voltaic pile had no influence on the electricity it contained, while the electricity of the torpedo was entirely under the control of its will, the torpedo refusing to give a shock at one time, but readily discharging its batteries at another. What was perhaps still more remarkable, there were two large lobes in the brain of the torpedo which regulated the production, storage, and discharge of the electricity. These electric lobes were composed of numerous giant nerve cells, from which numerous nerve fibres extended to pass direct to the batteries. When the electric lobes were destroyed or the nerves passing from them were divided the torpedo was rendered as helpless as an engine without steam. The lecturer then proceeded to describe the structure of the electric organ of the torpedo. He stated that the battery consisted of an enormous number of columns or prisms—in the ordinary torpedo from 400 to 500, in the American about 1,000, making in the two batteries 2,000 columns for storing electricity. In each of the 500 columns there were about 600 electric plates, so that in the ordinary torpedo there might be about 300,000 electric plates altogether, and in the giant torpedo some 500,000. These plates were supplied with an enormous number of nerve fibres, so fine and dividing more and more that with the highest power of the microscope it was impossible to trace them. Each of these tissues was connected with the electric lobes in the brain, and when cut across were seen to be made up of a large number of nerve cells. The lecturer described in detail the structure of the electric plate, and went on to say that the electric organs claimed special attention, not only because of their remarkable structure and still more remarkable properties, but because their very existence was a mystery. Mr. Darwin found the electric organs a special difficulty to his theory of natural selection for two reasons —he was able neither to understand their individual nor their ancestral history. That the electric organs had been gradually built up as the torpedo and electric eel became more and more specialised, Darwin had no doubt; but he was unable to account for their origin by his law of natural selection. And before proceeding he emphasised the difference between evolution and natural selection. We spoke of the fact of evolution, but the theory of natural selection, for while all naturalists now agreed that animals and plants had been evolved, there was still some diversity of opinion as to the method by which the evolution had been effected. In reference to any plant or animal it would be said by most naturalists that it was slowly evolved out of a mass originally shapeless of growing protoplasm by means of natural selection operating on fortuitous variations. As to the guiding hand, science must be absolutely speechless. In asking science to tell us what was the cause of causation, we were asking her to cross an impassable channel, to pass from the domain of fact to that of belief, a feat which if essayed must inevitably end in failure. Returning from this digression, Professor Cossar Ewart went on to remark that when, thirty years ago, the "Origin of Species" was launched on its wonder-working career nothing was known of the ancestral history of the torpedo. Now the position was altered, and he was able to tell them not only what the torpedo's organs had been derived from, but also to trace every step in their life history. To redeem his pledge, he went on to direct attention to the so-called "pseudo electric" organs of skate. He pointed out that fifty years ago no one ever suspected that the skate was possessed of electric batteries, and that until a few months ago naturalists would probably have expressed surprise had it been suggested that there was considerable diversity in the form and structure of the electrical apparatus of the various members of the skate family. The discovery of the existence of the electric organ of the skate was due to Dr. Stark, of Edinburgh, who read a paper on the subject before the Royal Society of Edinburgh in 1844, but having been labelled by naturalists "pseudo-electric," it had been until quite recently neglected alike by physiologists and naturalists. But the skate's organ was coming to the front again on account of the light it threw on the development of the powerful battery of the torpedo. The discharges from the skate's batteries, though weak, and as far as had been ascertained useless, behaved exactly like the discharges from the torpedo. The skate did not keep its electric battery at each side of the gill like the torpedo, but carefully tucked away in the tail. He described at length the structure of the electric organ of the skate. Instead of consisting of a series of plates, it consisted of a series of discs or cones fitted into each other like thimbles, and forming a long electric spindle. Each disc consisted of several distinct layers. The first layer, into which all the nerve-fibres pass, was not unlike the electric plate of the torpedo. Altogether, in the electric organ of the skate there might be 25,000 discs, or 50,000 in the two electric spindles. In other skates, instead of the discs, there were numberless cups, each cup having led into it numerous nerve-fibres. He further showed that in other instances the electric organ was composed of muscular cups; and in the young of the skate the process of development of the muscular tissue into the electrical organ was traced. In the same way, he said, the electric organ of the torpedo, notwithstanding its extreme complexity and remarkable powers, had been formed out of ordinary muscular fibres. For some inscrutable reason, the fibres of certain muscles concerned in moving the jaws of the ancestral torpedoes became more and more modified generation after generation, until they entirely lost their original function, and were so profoundly altered in structure that it was no longer possible to recognise in them the remotest resemblance to muscular tissues. But though he had been able to show that the torpedo's electric organs had been thus evolved, he had to admit that he only dealt with one of the difficulties—he had said nothing of the manner in which the transformation had been effected.

ROYAL GEOGRAPHICAL SOCIETY.

At the meeting held on November 26th, Mr. J. Thomson read a paper on "A Journey to the Atlas Mountains," before a large audience. General Sir B. Walker, K.C.B., presided.

Mr. Thomson, in the course of his paper, said that the idea of visiting Southern Morocco and the Atlas Mountains first dawned upon him in 1885. At that time he was engaged in a mission to the Central Soudan, and the infant civilisation he there found flourishing made him desirous of studying its parent resources. Until recent years Leo Africanus, a Moorish traveller, remained the sole authority on the subject of Southern and Central Morocco and the Atlas Mountains. The first really serious attempt to follow in the footsteps of Leo was made in 1871 by Sir Joseph Hooker and his companion, Mr. Ball, who brought back with them vast stores of botanical information; but much then still remained to be accomplished. Accompanied by a young friend, Mr. Harold Crichton-Browne, Mr. Thomson said he left England in March, 1888. Arrived at Casablanca, he secured the services of a Moorish soldier, and thus scantily attended they rode overland through the provinces of Shawia, Dukalla, and Abdar to Mogador. As far as the river Tensift the country traversed might be described as a gently undulating, upraised sea-bed, forming a low plateau or broad step, nowhere rising above 500 feet in elevation, and composed in great part of tertiary shell sands. It was a supremely monotonous country, chiefly distinguished by the complete absence of trees and the scarcity of the population—the result of Moorish misgovernment. The travellers passed from areas ablaze with a gorgeous carpet of flowers to tracts of bush and palmetto, or traversed rich plains of black loam, covered with splendid crops of barley and peas, alternating with fields left waste and desolate. Only one stream, the Um-er Rbia, found its way through this region from the mountains. With their arrival at Tensift all this disappeared. Here commenced the area of Argan forest, that peculiar and useful oil tree which found sustenance where the more water-loving olive could not live. They obtained their first view of the Atlas mountains on leaving the plain of Akermut, near Jebel Hadid. With their arrival at Mogador, with its gleaming whitewashed houses, they commenced operations for an excursion to the Atlas, and on the 7th of May they left Mogador with a little party of five men. As travelling in Morocco was a new experience, and the Moorish character an unknown quantity, he judged it best not to plunge straight into the interior until he had satisfied himself to some extent on these points. For that purpose he went by a circuitous route to Saffi through Shiedma. It was well that he did so, for the few days devoted to that trip revealed a state of things among his men which almost reduced him to the verge of despair. Their laziness, insolence, gluttony, and deceit were quite a revelation, and he speedily saw that the first essential to successful progress was the settlement of the question who was to be master. Arrived at Saffi they directed their steps to the city of Morocco. The route led over the raised sea-bed of Abda, till, reaching the second step of the plateau, they left Abda behind and entered the province of Beled-el-Hummel, or the "Red Country," so called from the colour of its soils, the result of the denudation of the red and purple cretaceous shales, which here were largely developed. After passing the small salt lake called Zima, on the fourth march, they left behind them the hills of Rahamna and entered the great plain of Morocco, the dried-up bed of some ancient lake. Here for the first time the Atlas range burst upon the traveller in all its massive grandeur as it rose abruptly from the plain and passed by successive irregular terraces into one or two prominent snow-clad elevations, though in the main presenting an even sky-line. At their arrival at the city of Marakish the real difficulties of the trip commenced, as they were on the threshold of untrodden paths. The base of the mountains was reached at the small ruinous town of Sidi Rehal, where an interesting geological feature attracted their attention in the occurrence of a continuous boss or dyke of basalt, which, as investigation showed, extended from Demnat to the Wady Nypes. Words failed him to describe the charming valley in the centre of which the little town of Demnat stood. Irrigation channels spread themselves in a perfect network over the entire valley, everywhere spreading fertility. In their first excursion from Demnat they were led up this picturesque valley, and some miles above the town, where the first narrowing valley seemed to end, they discovered the wonderful natural bridge aqueduct of Iminifiri. On reaching this strange natural phenomenon they saw what appeared to be the mouth of an enormous cave, as its name denoted, from which rushed the Wadi Demnat in a boisterous torrent. On entering they found themselves under a magnificent arch hung with stalactites, with walls presenting all the aspect of clustered pillars. Pushing their way in, they soon discovered that it was no cave, but nothing more than an arch, springing at a height of over 100 ft. from one side of a mountain gorge to another. The rocks around Iminifiri had an added interest in being clad in masses of the gum euphorbium. Above Iminifiri they crossed a valley broken by numerous hills which ended in sharply tilted limestone peaks, rising abruptly into mountain masses 6,000 ft. or 7,000 ft. high. The most prominent of those peaks they ascended, and discovered the ruins of a so-called Christian church, which, in his opinion, belonged to a pre-Christian era. But the goal of their trip was Tasimet, a place south-west of Demnat. That proved to be a lovely and picturesque spot cradled among mountain heights. Around were magnificent groves of walnuts and pine woods crowning various rocks and heights. It was an occasion of no small anxiety when the day arrived for leaving Demnat, and starting for the point selected for the first serious attempt to cross the mountains. Before starting they secured the services of a Jewish interpreter, who made them perfectly independent of the services of their men. It was only when they were well into the mountains that the situation dawned upon the latter, and then their faces were a sight to see. In a short time they reached the glens of the Lar and the Lemulha cut through purple shales, the bright colours modified by patches of bush or grass. Passing through the village and market of Enzel, they struck the Wad Gadat, up whose rugged glen their way lay into the heart of the mountains. Along this track there were no villages, and the sides of the glen were well clothed with callitris and juniper and at places an evergreen oak. Further up the glen, which soon became a gorge, lay the picturesque district of Zarktan. There the Gadat divided and spread itself in radiating tributaries on the northern face of the central range. From Zarktan the road to Glauwa zigzagged up a high, narrow ridge which soon brought them to the foot of the Atlas crest. Far below on their right ran the Gadat, the gorge of the Asif Adrar-'n-Iri flanked then on the left, while the bright-hued ridge they stood on led to the entrance of the gorge, which ended in the pass across the mountains. Struggling up the gorge of the Adrar-'n-Iri, over rugged, angular blocks for some time, they arrived at the district of Tetuta, where the gorge expanded and ended in the very heart of the Atlas range. A more desolate prospect could never be seen, irresistibly reminding them of Aden. Hardly a tree or bush was to be seen, only a little grass on the small, irrigated terraces. The next day a sharp climb of an hour brought them to the top of the pass, the Tizi-n-Teluet, at the height of nearly 9,000 ft. A view of magnificent extent spread itself out before them. Southward the eye roamed far into the hazy distance over the basin of the Draa, and northwards scanned the glen of Gadat, the plain of Marakish, and rested on the mountains of Bahamna and Srarna. As far as the eye could reach there was only a slightly broken plateau region 7,000 ft. to 8,000 ft. in altitude, without a conspicuous feature to catch the eye. Even in colour it was mournful and monotonous in the extreme; a deadly gray which spoke of friable shale and general barrenness, unrelieved by green forest or bush. The one refreshing feature of this disappointing landscape was the little valley of Teluet, which lay 3,000 ft. below them, resembling the dried-up, grass-grown bed of a mountain lake, which, indeed, it might have been. On either side of the pass the moun ains rose 2,000 ft. above, like the rugged pillars of a gate. In the valley of the Teluet the Kaid of Glauwa had his castle, where they were hospitably entertained for some days. Being foiled in their attempt to proceed west along the southern aspect of the main axis, they recrossed the Tizi-n-Teluet and passed down the glen of the Gadat, reaching the Kasbah of Misfiwa in two big marches, and in a single march of fourteen hours they went straight from Misfiwa to the Kasbah of Gurguri, arriving early the next day at Amsmiz. From that point they again went into the mountains, their object being to reach the small mountain province of Gindafy, and their route lay up the Amsmiz. At midday they succeeded in reaching the top of the Tizi-Nemiri at an elevation of 9,600 ft. On crossing the Tizi-Nemiri Mr. Thomson said he had seen a very conspicuous snow-clad peak to the west, and a great desire to ascend it had taken possession of him, as it was evidently the highest point between Wady Nyfis and the Atlantic. Leaving his friend—who was at that time ill—behind, and taking only three men and a soldier guide, he went west to the Wady Nyfis, and reached Marossa on the same day. From Marossa he turned east, skirting the base of the main axis to Eduz, and then started for the district of Ogdinit at the foot of the peak. Even the most faithful of his three men were in a terrible fright at having to venture into a more than semi-independent district. But he was not to be turned from his purpose, and succeeded in reaching his destination. He was, however, at the time placed in a most critical situation, the ascent of the peak developing into a race in which he was chased by the natives and had more than one narrow escape of being shot. It took him some time to recover sufficiently to take any observations, but when he was able the prospect displayed sufficiently repaid him. From that vantage point, 12,500 ft. above the sea, he could see 10,000 ft. below him the river Sous in glittering reaches, winding seaward through the grove and field mottled valley, gathering within its banks a score of streams from the mountains. The chief attraction, however, was the sight of the massive elevation of the Anti-Atlas, whose table-like top formed an almost straight line on the horizon. East, west, and north a bewildering assemblage of snow-streaked peaks, sharp barren ridges, gorges, and glens rocky and desolate above, grove fringed and terraced below, met the eye, making description almost impossible. Mr. Thomson then described a short stay they had at the city of Marakish, and went on to speak of the ascent of the Tizi Likumpt at a height of 12,500 ft. Here, rather to their surprise, they found a branch of the Mrika river, penetrating into and running parallel to the central axis. On the 9th of September they started on a hazardous trip up the valley of the Imintanut, which was a very narrow gorge, caused by the occurrence of an almost vertical bed of compact limestone. They then passed into another glen, that of the Wady Msira; crossing that depression, they rose rapidly for half an hour, and at an elevation of only 4,500 ft. they found themselves at the top of the pass that led into a tributary of the Sous. The impression that was acquired at the end of that pass or watershed was that they were skirting the end of the Atlas as a range, and that westward lay only a broad plateau, cut off geologically and topographically from the range to the east. They then travelled through Bibawan to Tarudant, and traced out the tail of the Atlas range, and remarked the manner in which the cretaceous sandstones were thrown on the flank of the range, though comparatively undisturbed away from the immediate line of upheaval. The lecturer then said that, after returning to Casablanca, a despatch asking him to go to the relief of Emin Pasha brought him home, or he had intended to do a little more exploring. In conclusion, Mr. Thomson gave some of the practical results of his trip. They had ascended and crossed the Atlas chain in no fewer than six different places besides making various subsidiary trips into the lower ranges. A large series of barometric and boiling-point observations had been taken which would assist in forming a more accurate idea of the general elevation of the range. Several glens had been explored and the head-waters of some important streams had been mapped out. New and important light had been thrown upon the geological structure of the mountains. A small collection of plants from the higher altitudes had been made, and finally a series of photographs (which were exhibited) of the mountains, the inhabitants, and their houses had been obtained. He had reached an altitude in the mountains 1,300 ft. or 1,500 ft. higher than any other traveller.

ROYAL STATISTICAL SOCIETY.

The first ordinary meeting of the present session was held at the Royal School of Mines, in Jermyn Street, on the 20th ult. The President, Dr. T. Graham Balfour, F.R.S., Honorary Physician to her Majesty the Queen, occupied the chair.

Before delivering his inaugural address, the President congratulated the Society upon its continued prosperity and numerical strength, and referred in terms of regret to the losses the Society had sustained by deaths since the anniversary meeting in June last, especially mentioning the services rendered to the Society in the past by Mr. Frederick Purdy and the Rev. E. Wyat-Edgell. He also urged on the Fellows generally, and the younger ones especially, the importance of forwarding the objects of the Society.

The President then proceeded to show how errors may arise in the use of figures under certain conditions, and some of the benefits to be derived from statistics when correctly and carefully employed. In illustration, reference was made to the assumption that town life leads to physical degeneration, as argued in an article on the "Health and Physique of our City Populations," in the *Nineteenth Century* of July, 1881, recently reprinted in "Prosperity and Pauperism," edited by the Earl of Meath. Other subjects and instances were also mentioned, showing how easy it is to arrive at erroneous conclusions from a comparison of two periods without regard to the important principle of similarity of the conditions.

Dundee Naturalists' Society.—At the meeting on November 21st a paper on "The Origin of Coral Reefs" was read by Mr. Alexander P. Stevenson. After drawing attention to a large collection of corals from the Biological Museum of the College which had been kindly lent by Professor D'Arcy Thompson, Mr. Stevenson pointed out that these coral masses were composed of the skeletons of myriad organisms which had lived in tropical seas, and secreted the limestone of which the skeletons were built up from the lime present in the ocean water. The reefs were not built up by the corals in the sense in which we generally understand building. The builders were unconscious, and showed neither toil nor skill, but, dying, left their skeletons to form a basis on which other generations could repeat the same process of growth and decay, and by the fusing together of the innumerable skeletons, the "bricks" were formed of which the reefs were the aggregates. The coral was shown not to be the "insect" of which one frequently hears, but a near relation of the sea anemone, which lived in colonies, and had the power of secreting a skeleton in its tissues. A description of the coral polyp was given, and illustrated by beautiful models and blackboard sketches. It was shown that the fact of the organisms only being able to live in water where the temperature never fell below 60 degrees practically limited the reef-building corals to the region of the tropics. The difficulty involved in explaining the origin of coal reefs, more especially those annular rings of coral with a lagoon of smooth water in the inside, and on the outside the surging breakers of the fathomless ocean, and which were known as "atolls," was shown to consist in the fact that the corals could not exist at a greater depth than twenty fathoms, while outside these reefs the soundings revealed enormous depths. How, then, had they risen from the deep-sea bottom? The various theories suggested by early naturalists were touched upon, and the views of Darwin, Agassiz, Le Conte, Semper, John Murray of the *Challenger*, and Dr. Guppy explained at length the weakness or strength of each being pointed out. The conclusion reached was that of honest Sir Roger de Coverley, "that a good deal might be said on both sides."

Geological Society of Glasgow.—At the meeting held on November 19th, Mr. Dugald Bell, vice-president, in the chair, the following gentlemen were elected to fill the vacant offices in the council:—As Vice-President, Mr. Forsyth Sommerville: as members of Council, Messrs. William Armour, C.E., William Jolly, F.G.S., R. J. Steele and James S. M'Lennan. Mr. John Young, F.C.S., exhibited specimens and sections, under the society's microscope, of a variety of Ormund stone (a volcanic tuff), enclosing pearl-sinter or pearlite, from Corrieburn, Campsie. In the sections it was seen that the interspaces between the fragments of erupted rock had been penetrated at an after period by a fluid aqueous magma, probably in a heated condition, and which held in solution several mineral elements, such as silica, alumina, lime, and iron. The last three of these appear to have been the first to gather together in the form of small spherical balls, more or less polygonal in outline in section, with a faintly radiated crystalline structure These spheres are seen to have been afterwards enveloped in the silica of the magma, as they have a glistening pearly grey coating, resembling that known as pearl-sinter or pearlite, which has been found in volcanic tuffs from various parts of the world, although apparently not previously recorded from Scottish volcanic rocks of carboniferous age.

Liverpool Science Students' Association.—At the meeting on November 16th, a short but interesting paper on "Instinct in Plants" was read by Mr. R. H. Day. A paper on "The Philosophy of Cross-fertilisation," a subject of great interest to botanists, was read by Mr. J. W. Baylis. The wonderful variety of flowers in form, colour, and odour was graphically pourtrayed, evidencing that they were factors in the production of cross-fertilisation, which consisted in the fertilisation of the ovaries of flowers by pollen from other flowers of the same species, effected through the agency of the wind or insects. The conveyance of pollen is essential in the great majority of plants, the sexes in some cases being borne on separate flowers, and even when the male and female organs are united in an individual, self-fertilisation is made difficult or impossible by various causes, such as the relative positions of the organs and the different periods at which they arrive at maturity. The curious contrivances and modifications that flowers, especially orchids, possessed for the furtherance of cross-fertilisation, and the inter-dependence of flowers and insects in the struggle for existence, were alluded to at considerable length. In closing, the essayist referred to the researches in this direction of the late Charles Darwin, and said the theory of natural selection was alone adequate to explain the phenomena. An interesting discussion followed, many members taking part, after which Mr. W. Read exhibited in the lantern some interesting slides illustrative of the coal measures of the Wigan coal field.

St. John's Natural Science Society.—At the meeting of this Society on November 27th, a lecture was delivered by Mr. J. W. Slater, F.E.S., on "Nature's Sanitary Service." The lecture was illustrated with specimens of the insects most active in removing putrescent or morbid matter.

Falmouth Naturalists' Society.—At the meeting held on November 26th, the Rev. A. R. Egar (President) in the chair, the Rev. J. A. Leakey gave a lecture on "The Antiquities of St. Gerrans."

FLINTS.*

PROFESSOR J. W. JUDD said he must commence by apologizing for slightly altering the order in which he treated the subject that he had to bring before them, owing to some alterations necessary in the microscope-lantern not being completed. He would, therefore, that evening proceed to speak of the modes of occurrence of flints, leaving the microscopic treatment of flints for the next lecture, when he hoped to be provided with the necessary apparatus. In the remarks he had addressed to them in previous lectures he had endeavoured to point out what could be found out concerning flints by means of experiments. Experiments, as they would have perceived, were simply ways of observing how Nature acted, but in experiments they, as it were, laid a trap for Nature. They determined the conditions themselves under which Nature should act, and then watched the process she followed. But the geologist was often quite unable to follow out that mode of inquiry by experiment. Often it was not possible for him to lay down conditions under which Nature should act. He could only take advantage of the circumstances, and observe what took place under various conditions. Then they spoke of that mode of inquiry as "observation." They would see that "observation" and "experiment" agreed in the fact that in both cases they were observing the action of Nature, but in experiment they themselves determined the conditions under which Nature acted, whereas in ordinary observations they were obliged to take advantage of any opportunities that were afforded them of seeing how Nature worked. The object of experiments and observations was to obtain a number of facts upon which they could reason, and the reasoning which they founded upon these facts and observations was called inductive reasoning. When they had obtained a sufficient number of facts and observations they might form a theory—it might be but a working theory —to account for the facts that they had observed, and they might then proceed to try that theory by other facts, and if it held, to extend and elaborate the theory; or if they found that the theory would not hold good, to give it up. That was the process which was continually carried on in scientific work, and he was going to ask them that night to inquire what "observation" taught them concerning flints, what facts they were able to learn from certain flints which would enable them to make scientific inductions concerning the mode of origin of those flints.

They would inquire what was the mode and occurrence of flints; in other words, where did they come from? Now every Londoner knew that there were two sources from which flints were obtained. Sometimes flints were observed having a beautiful outside coating with a grey or black interior, which was exhibited on fracture. They were all familiar with ordinary white flints with black interior as being employed so commonly in rockeries, and sometimes very ingeniously at railway stations, to pick out the names of the railway stations in large letters. They were all familiar with those large flints; very irregular they were in form; and generally those large flints were obtained from the chalk. They were got out of the chalk beds and were brought to the places where they were used in the way he had described, and in many other ways. But they were equally familiar with another kind of occurrence of flints. They saw flints which had not that black or grey colour, and which have not white coatings outside. The flints may be black or grey, but they were not unfrequently brownish, or reddish, or yellowish in colour, and they were very different in appearance, and they were without irregular and fantastic forms that they were acquainted with in the flints from chalk beds. These flints had various forms. Sometimes they were almost perfectly angular; at other times the edges were worn off and rounded. They were spoken of as subangular flints. In other cases a mass had been worn into a perfectly rounded form, a form called a pebble. Between those several forms they found every possible gradation. They might find flints which were evidently produced by fracture and fracture only. The edges were perfectly sharp and well defined. They might find others in which the process of wearing down had gone on but a little way, and the flint was thus sub-angular; and others in

* Third Lecture to Working Men at the Royal School of Mines.

which there was so much worn away that it was converted into the peculiar rounded form of the pebble; those pebbles were nothing but water-worn flints. Here was a case where they were obliged to fall back upon observation. Nobody could watch for himself the actual wearing of the actual flints and pebbles, but by examining all those cases they might convince themselves that without doubt the flint-pebbles were merely angular flints that had been worn and rounded. In that way they arrived at the conclusion that those sub-angular and rounded flints, which occurred in the gravels beneath and around London in such great abundance—that those flints were nothing but flints from the chalk which had undergone this process of rounding and rolling by the action of the water. It was true that their colours were very different in many cases from the colours of ordinary black and grey flints, but, as he had pointed out to them, the colour depended upon the very minute quantities of foreign substances in it. He had shown them how small a quantity of gold would alter the colour of a great mass of water, and it was equally true that a minute quantity of iron combined with oxygen would alter the colour of a great mass of flint; and so far as the chemist was able to find out, there was very little difference indeed between those flints which were converted into a brown or red tint and those which retained their original black or grey colour. If any doubt existed as to these pebbles having come originally from the chalk, it would be dissipated by the fact that they often found shells and fossils, to which he would have to refer, in the middle of those rounded pebbles; and in all cases the shells and other fossils found in the gravel flints were the same as those found in the chalk flints, so that, after examining a great number of cases of that kind, they could not doubt for a moment that the flints which were found in gravels had been once flints imbedded in chalk. That being the case, then, they might dismiss the question of the gravel flints. These were once imbedded in chalk. They had merely been washed out and left behind on account of their hardness, while the chalk had been washed out and dissolved, and the flints had been gradually rolled into rounded forms, passing through the condition of sub-angular flints into the condition of pebbles.

Let them, then, go to the chalk itself, the original source of the flints, and inquire how the flints occurred in the chalk. They were all familiar with the chalk which appeared at so many points around London, points which they must all have visited. They had, no doubt, all seen the chalk pits on the downs, and in these days of easy transit probably all must have seen the chalk-cliffs in the Isle of Wight or along the south coast of England, where there were beds of chalk with layers of flint lying in them. They must all be familiar appearances of those chalk strata. Now, if they went to the chalk downs or to the chalk cliffs, and examined either the openings in the chalk or saw the cliff where the chalk strata were exposed, they would be able to observe the way in which the flints occurred. All who had visited the chalk cliff or bed must have noticed that sometimes chalk flints occurred, scattered in the most wonderful manner through the chalk. The flints were found lying, without any apparent order, in the midst of the chalk. They might pick away the chalk and suddenly come upon a little nodule, often very irregular. Sometimes it was perfectly rounded, like a bullet, but frequently it was a very irregular mass, lying quite isolated in the chalk. But besides these scattered flints, and much more abundant than them, were bands of flints, and all who had made a journey to Brighton or by any of the lines that run out of London, if they had looked out of the window, must have noticed how regularly those bands run for considerable distances. The layers or beds of chalk were marked out conspicuously by those bands of flint. Now he wanted to call their attention, in the first instance, to the fact that there were three varieties of these bands of flint. He might mention in passing that these bands of flint were very irregularly distributed. On the average the flint bands generally occurred some three or four feet apart, but sometimes two bands were seen quite close together. At other times a thickness of six, eight, and ten feet and more of chalk existed without flints. Now, these bands of flint were of two kinds. Most commonly they consisted of nodules, very irregular masses, exceedingly fantastic in form and outline, but arranged in tolerably continuous lines side by side. In the second place there was, though much more rarely, another kind of flint bands—what were known as tabular flints. These tabular flint bands were more or less continual for a very considerable distance. Very frequently when those bands were broken they could be seen to be not single bands, but double, consisting of two layers meeting along an irregular line in the middle. There was another fact to which he must call attention, and that was that sometimes these tabular bands give off layers or other tabular masses, more or less at right angles, and sometimes running obliquely from them, and the position in the chalk was that those tabular bands generally lay along cracks which were known as the jointing of the chalk, along which the rock split up with tolerable ease. So there was a tolerably clear distinction between those two kinds of flint bands, the nodular and the tabular.

Those were the chief varieties of flint that would be observed in the neighbourhood of London or in any part of the south of England that they were likely to visit. Either the flints were scattered through the chalk, taking very irregular form, or else they occurred as bands, the bands being sometimes nodular and sometimes tabular in character. Now, if they were to travel as far as Norfolk or the north of Ireland they would find flints occurring in still another manner. In addition to the bands and the scattered flint bands being sometimes tabular and sometimes nodular, more frequently nodular, they sometimes found flints of gigantic dimensions and of very curious form. A specimen exhibited was like a pot; sometimes it was closed at the bottom, and sometimes it was open throughout, and if they were fortunate to see them in a bed, as at Horstead, in Norfolk, they might find them arranged in a very singular manner. These flints were found to make vertical series. One flint seems to fit in the top of another somewhat irregularly, and another time they found a long series of these gigantic flints arranged vertically. These had received a very curious name, and the origin of the name was still more curious. He believed the name originated in this way: The celebrated geologist Dr. Buckland was making a tour in the north of Ireland, and he had as guide an Irishman who conducted him to places he wished to visit, and on his way the doctor picked up a great number of interesting things, and the Irishman, with natural curiosity, asked the names. The doctor gave some of those wonderful compounds of Greek and Latin which at first sight seemed so uncouth, and whatever the doctor picked up he had a wonderful name for it. At last the doctor came upon a thing he had never seen before—one of those gigantic flints—and then it was his turn to ask a question: "Why, Paddy, what do you call that?" Paddy saw his opportunity, and was equal to the occasion. "That, sir," said he, after a moment's consideration—"that, sir, is a Paramoudra." The doctor wrote it down in his note-book, and from that day to this they had been paramoudras. Unfortunately, the name sounds very much like a Greek name, and many persons had puzzled themselves about the Greek derivation of this name. He believed, however, it was only fair to mention that Gaelic scholars, people who were acquainted with all the niceties of the Irish language, assert that "paramoudra" is an Irish word signifying "big stone;" whether the Irishman fell back upon his Gaelic or invented a word on the spot I do not know, but ever since it had retained the name of paramoudra. Now, these gigantic paramoudras, or pot-stones, were very curious and enigmatical things. They would see presently that there were many remains of sponges in the chalk, and the nearest thing they could compare with these paramoudras were some gigantic sponges which were found in the sea, and which were known as Neptune's cup. It was suggested that as the mud which formed the chalk was gradually being accumulated at the bottom of the sea those sponges got on to it, and they gradually formed the paramoudra. The explanation was, perhaps, not a very good one, but at present they were not able to offer any other. The occurrence of these paramoudras was a very singular circumstance indeed. As he had mentioned, they did not occur near London, but only in Norfolk and North Ireland.

Now to return to more ordinary flints, with which they were likely to make frequent acquaintance, he would point out the fact that flints were often, when broken, found to be hollow. Every one who had looked at flints must have noticed the circumstance that if you broke some flints across you would find they were hollow in the middle; and every one must have noticed the fact that flints were sometimes partly black and partly white. Very frequently when flints were broken open they found an outside layer of white, and a great mass of the flint was black, and inside again the mass was white. He must remind them that that difference between black and white flint was a difference of very slight importance. They had already seen that if an ordinary black flint was ground to powder the powder was perfectly white, and there were many similar illustrations to the same effect that might be brought before them, such as a lava known as obsidian, and a piece of the same lava blown up into a froth by the gas which escaped from the mass. It was perfectly white and regular. They had seen how the green water of the sea, when lashed into foam, made a perfectly white foam; and the colour of that mass was due to the mode of aggregation of the water, and not to any change in the liquid itself. When the mass was blown into bubbles it became white. He must not enter into the physical cause of that appearance, which was due, as those who had thought anything about physical questions were aware, to the fact that instead of the light being reflected from one surface it was reflected from a great number of surfaces—from every film of glass or liquid which was formed when the mass was blown up into bubbles. When they came to study the microscopical characters of flint they would see why black flint in parts passed into white flint; but for the present it was only necessary to point out to them that black flint and white flint were varieties of the same substance, and if they analysed them they would find both to consist of silica, and nothing but silica. If they took an ordinary white flint and washed from the outside very carefully, all the adhering chalk, which they could do more readily with a little vinegar or other acid to dissolve the chalk outside, the flint would present a very striking appearance. If examined with a lens, it would be found to be covered with unmistakable marks of little shells. On the other hand, if they took one of the hollow cavities and examined the white material of the central part, they would find the white powder consisted of a number of curious little shells, many of which were of great beauty. A well-known geologist, Dr. Hinde, once found one of these paramoudra in Norfolk, and from it he obtained a whole museum of specimens. Carefully washing them out and examining them under a microscope, he found thousands and tens of thousands of forms, many of which he examined with great care and described, showing what a wonderful diversity of forms existed in the centre of these hollow flints. This white powder in many cases was not a shapeless mass—a mass of particles having no individuality; but if it be examined carefully with the microscope, it would be found that it consisted of little shells. There was only one point he would call attention to about these shells, and that was that though they consisted of silica or flint now, whatever they did once, if they were treated with vinegar or any acid they were not dissolved like ordinary shells would be, but they remained; they were, in fact, converted into silica. They would see they were once shells consisting of carbonate of lime, but now they consisted of silica.

He would point out one or two other facts that they must all have noticed about hollow flints. Sometimes hollow flints have their insides lined with beautiful little crystals, and if they had a lens—and he would advise them all to have a lens and use it—they would find that these little sparkling crystals were quartz crystals just like those beautiful quartz crystals to which he called attention in a previous lecture, only very minute. They were like quartz crystals, set very closely together with their points directed towards the central hollow of the flint. In other cases when a flint was broken open the hollow was found filled with a substance forming curious rounded nodular masses, and it was a substance to which mineralogists gave the name of chalcedony. He would have to refer to that chalcedony on a future occasion; but he would call their attention to the fact that sometimes they were found filling the hollow of the flint, sometimes crystals, sometimes the substance known as chalcedony.

He must also mention a fact you may have observed for yourselves, that sometimes flints have not a uniform colour and texture, but exhibit a curious arrangement of dark and light portions ranged in definite bands. Sometimes they might, in examining a flint, see that those banded portions, as they were called, had been formed after the other portions. They might see that there had been a hollow place in the flint, and that there had been a succession of layers of flint laid down, the layers having different tints, and filling up those hollow places. When such flints were worn into pebbles, they often found that the separate layers yielded very unequally to the process of wearing away by the weather. Some of the bands stood out in relief, while others were worn into curves. They might even find banded flints which were often mistaken for true fossils. Now he must refer them to the fact that flints sometimes possessed some other curious characteristics. There was a bed at Charlton, North Woolwich, where it looked as if there were flints; if one picked away the chalk the flint tumbled into a large number of little pieces. This showed that, through some upheaval, probably, the flint had been smashed to pieces, but the chalk had held every portion in its place, and they did not see that the flint was smashed up until they removed the surrounding chalk. The fact was that the beds had been subjected to great movements, and during the movements the crushing operations had taken place, but the flints had not been able to fall to pieces, on account of the surrounding chalk. Sometimes one came across a still more curious circumstance—a flint had been sometimes broken up into pieces, and fragments had been more or less displaced, but after the displacement the flint had been cemented together again, and so perfectly mended, that if one tried to break it it would break anywhere except along the original fracture—just as it was said that if a man's arm was broken, if he had an accident again it would not break again in the same place. So with fractured flints. It was evident that a remarkable process of fracture and mending had gone on in the flints.

He must next call attention to the fact that flints not unfrequently contained fossils, that was, remains of animals and plants that had once lived, and a very great number of fossils had been found in flints. Those fossils sometimes occurred in one way, and sometimes in another. Sometimes the fossil was a wonderful replacement of the original shell; sometimes they got what looked exactly like an ordinary shell, which they knew to consist of calcic carbonate, and when they examined them carefully, instead of consisting of calcic carbonate which dissolved easily in vinegar or other acid, they found it consisted of the totally different substance, silica. That those shells such as oysters and other well-known forms of shell were once formed of the substance calcic carbonate there could not be the slightest doubt. The whole of the original substance of the shell had been dissolved away, particle by particle, and another particle of silica had been put in the place of the several particles of calcic carbonate, that is chalk matter, until the whole mass had been converted into silica or flint. But at other times it was evident that the process of making the fossil had gone on in a totally different way. Some fossils exhibited were evidently remains of shells of sea urchins, but if they examined them they found that the shell had not been preserved, that they had a cast or impression of the inside and another cast of the outside, and the place where the shell itself was, was now perfectly hollow, as in cases such as exhibited. So that when they got a perfect fossil they had the cast lying in the midst of the flint, and the space occupied by the original shell had been completely dissolved away. In a specimen exhibited they got the outside shell perfectly impressed on the flint. Inside the shell every little hole and marking most perfectly preserved an exact impression such as one would be able to take with sealing-wax or plaster of Paris in the midst of the shell. Then in another case exhibited they had an external cast and an internal cast. He would have to refer more particularly to these casts, and the way in which they originated in a future lecture. Sometimes they found that the shell, like one produced, resembling the great pinnæ that lived at the present day, had been worn away, but while the shell was living, sponges, which made their home in shells, had burrowed into the substance of the shell. These burrows had been filled by white chalk mud, which filled the fossil originally. Now a curious thing had occurred. This chalk had been converted into flint, but the substance of the shell was removed, and thus perfect casts were obtained of those wonderful burrows. They would find subjects of infinite interest and variety in the study of those curious fossils which occurred in flint, especially if, as he hoped to be able to point out, they could reason as to why in some cases they got a cast, and in other cases got the actual replacement of the shell.

He must now ask them to direct their attention from the flints to the chalk in which the flints occurred. That chalk —as they were all aware now the subject had been so frequently explained—had a most wonderful resemblance to the white mud which was found occurring at the bottom of the Atlantic, and which was brought home by the *Challenger.* This mass contained a quantity of sticky material known as globigerina ooze, which covered a large portion of the bottom of the Atlantic. It was not quite so white as chalk, but in other respects it resembled somewhat grey chalk reduced to powder. If they placed some fragments of chalk which had been washed carefully and some of the globigerina ooze under a microscope, it would be seen that they presented a most wonderful resemblance. What he had now to call their attention to was that, if they examined this Atlantic ooze and chalk much more carefully, they would find that Atlantic ooze contained objects which were not found in the chalk. If they dissolved away with a little vinegar or other acid, the chalk would have very little left. If they took Atlantic ooze, and with a little vinegar or other acid dissolved away the shells, which were composed of calcic carbonate, they would in most cases find left behind a great number of minute objects, and if they were examined they would be found to be very interesting objects indeed. A careful examination would show that they were composed of silica —that kind which was called colloidal silica, and when they came to look at their forms it would be seen that they were very definite structures indeed. They were skeletons of curious organisms, some of which were plants and some animals. The plant formations were very minute forms indeed. Drawings of the very beautiful forms known as the diatomaceæ, which had skeletons composed of colloidal silica. Every little plant was simply a little cell, and consisted of a membrane containing a liquid, but each of those little cells had the power of secreting a skeleton which was of very curious form. It consisted of three portions like a box. First there were two discs, which were sometimes round and sometimes had very curious shapes as represented in other figures, and between them there was a double girdle so that the two parts fitted into one another. These skeletons were so excessively minute that they could only make out the forms and marking with a very high power microscope—a power of $\frac{1}{4}$ inch or $\frac{1}{8}$th inch or even higher power. If they examined them with such high powers it would be found they were covered with most beautiful patterns and markings, something like specimens shown in a diagram, which, however, represented only a few of the infinite variety of those exquisite forms of vegetable life. In addition to the plants there were skeletons of minute animals. Those larger organisms were skeletons of animals known as radiolarians. There was a wonderful diversity of beautiful forms represented in a diagram exhibited, but they were only a very small selection indeed out of the thousands of wonderful forms that were known and had been described by microscopists. Last of all they would find a number of rods and plates, often assuming very curious forms, and these they would recognise as being portions of the skeleton of curious sponges—of which specimens were on the table—sponges which had skeletons composed entirely of colloidal silica built up into rods and plates in the most complex patterns, as represented in diagrams produced. Now, they found none or scarcely any such objects as those in chalk when it was dissolved in acid, but in the globigerina ooze they would find them.

He must call their attention for a moment to the chemical composition of the different rocks forming the chalk series. He had already pointed out to them the way in which chemical analysis was carried on, and he had with him some results which had been obtained by analysing some different kinds of chalk, and beds which lay below the chalk in the South of England and elsewhere. Many of those present might have noticed the fact that flints were confined to one portion of the chalk. In the upper part a great thickness of chalk with flints was found, whereas in a lower part there was no chalk flint, and that difference was accompanied by other differences. Chalk which contained flint was of a beautiful white colour, and chalk which did not contain flint was more or less of a grey tint. Many of them could recognise in their visits to the seaside that the upper part of a cliff contained flints and the lower part none. If they examined the chalk they would find that the chalk with the flints consisted entirely of the pure substance calcic carbonate, and there was only a very little silica, but if they took a mass of the lower chalk they would find the quantity of carbonate of lime was somewhat less, but the quantity of silica was much greater. The suggestion offered itself at once that in the upper chalk the silica had been separated out to make the flints, while in the lower chalk the silica remained distributed through the chalk. Now that was the first suggestion which struck one, and they would presently inquire whether they were able to verify that working hypothesis. If they examined the other beds below the chalk they would find that many of them contained a considerable quantity of silica, and they also contained sand and other substances that could be washed out of them, but into that subject he must not at present enter further.

Now let them ask two questions that would be of great use to them in their future inquiries: Were there any rocks besides flint which consisted of silica and silica only? All substances known as sand and sandstone, and the very hardened variety known as quartzite consisted almost entirely of silica, but they differed from flint in the fact that while flints appeared to have a very uniform texture, when examined by a lens or microscope, the sand or sandstone, or quartzite, would be seen to be made up of little fragments, these little fragments being derived from granite and other rocks which contained the substance silica, so they might put aside sandstone and quartzite as having but little analogy with flint except that they consisted of silica, but their silica had evidently been derived from the breaking up of other rocks. But there were other substances which presented much closer analogies with flint. First of all he must call their attention to the fact that in some parts of the world they found hot springs which rose from the ground: the great hot springs which occurred in Iceland, known as geysers, and also in Yellowstone Park, North America, and in New Zealand—these springs coming from the ground boiling hot and rising into the air to a great height, and making great eruptions. But this hot water contained in solution large quantities of silica, and when the hot water cooled down the silica was deposited. The silica left sometimes formed basin-shaped hollows, sometimes masses like cones known as geyser cones, and at other times it formed curious sorts of cups forming most wonderful natural bathing places like the White and Pink terraces which were unfortunately destroyed in the great eruption of Tarawera in 1886. Now, the silica had evidently been held in solution by the water, and as the water had cooled, that substance had been left behind, building up beautiful and wonderful structures. Just as they dissolved silica in alkali, and then made it separate from the liquid by adding acid, so they had in those cases the like action of the hot waters containing various acids. These acting upon the lavas of the districts, they got silicate of soda and of potash in solution, the silica being left behind in a colloidal form. Now he must call their attention to another class of substance which presented some analogy to flint. They not unfrequently found deposited a mass of materials entirely composed of the skeletons of different organisms which had skeletons made up of the substance silica. Many years ago Sir Joseph Hooker found out that at the bottom of the Antarctic Ocean there was a mass of white mud entirely made up, or almost entirely made up, of the remains of beautiful plants—the skeleton of the wonderful diatomaceæ, hundreds of varieties being present in countless millions; and the observations of Hooker had been confirmed by the explorations of the *Challenger* and other vessels. In other parts of the ocean, however, they found a great mass of rock, entirely made up of the remains of the diatoms. There were skeletons composed of colloidal silica which were much larger than those of the diatoms, and sometimes they found masses entirely made up of the remains of sponges and radiolarians. In various parts of the country where lakes had been drained or filled up they also found masses of white material which were also found when examined under the microscope to be made up of these minute plants, skeletons of diatomaceæ. This substance, which was used for making dynamite on account of its great absorbing power, was composed entirely of these excessively minute skeletons of this curious plant, the diatoms. In other places they found great masses of rock, as in North America, especially in the Island of Barbadoes, made up of radiolarians, and in other places they found deposits crowded with fragments of the curious siliceous sponges. He thought they were now in a position to profit by the investigation that they would be able to make by aid of the microscope, as to the actual structure of flints, and from the study of the microscopic structure of flints he hoped they would be able to draw some inferences as to the probable mode of origin of the flints. It had been necessary to bring those general facts before them in order that they might reason upon the facts that they would observe by the aid of the microscope.

RECENT INVENTIONS.

The following list has been compiled especially for the SCIENTIFIC NEWS *by Messrs.* W. P. THOMPSON *and* BOULT, *Patent Agents, of* 323, *High Holborn, London, W.C.; Newcastle Chambers, Angel Row, Nottingham; Ducie Buildings, Bank Street, Manchester; and* 6, *Lord Street, Liverpool.*

TELEPHONIC APPARATUS.—Messrs. G. L. Anders, J. S. Sawrey, and H. Collet have patented improvements in telephonic apparatus. By this invention a support for a telephone is combined with an automatic switch. A horse-shoe receives the edge of the mouthpiece of the telephone which is cut to a suitable shape to slide into the horse-shoe. The telephone when placed on the base and within the horse-shoe presses down one or more contact springs or switches by the weight of the telephone, thus being automatic and reliable.

BRIDGES.—E. W. Ives has patented an improved bridge. It consists in placing trussed triangular girders, parallel to each other, encased with iron to float them, across the waterway at such a height and with such openings as to allow small craft to pass through the bridge when placed on its bearings in position to carry traffic. To move the bridge for the passage of large vessels, it is lifted or lowered from its bearings by moveable pontoons, after which the bridge is connected by locking bolts to radial arms working freely on a vertical post.

ELECTRICAL FUSES.—Mr. W. E. Hayne has patented a safety fuse for electrical circuits. A short piece of fusible material is placed in the circuit, the fuse being acted upon by springs which exert a pulling or pushing force upon it. When the strength of the current is in excess, the fusible material becomes plastic and is broken by the spring force, the circuit being thus broken. The breaking of the fuse is utilised to bring into circuit, automatically, a second fuse to take the place of the one broken, so that the circuit may be again completed without loss of time.

DISTANCE RECORDER.—Mr. R. M. Lowne has patented means for indicating the distance run by cycles or velocipedes. The object is to obviate the disadvantages of ordinary automatic indicators, and to provide one that will revolve with the crank of the cycle, and notwithstanding the machine being geared up, such as in safety machines, it will register the distance travelled at any speed correctly. This automatic indicator is of a very flat construction, its thickness not much exceeding the thickness of the cycle crank, and attached to this indicator is a strong clip of gun metal with projecting lugs and a screw to firmly grip the cycle crank.

ELECTRIC REGULATORS.—Mr. N. Benardos has patented an improvement in electric regulators. The object is to regulate currents by introducing electric resistances in the circuit. A metal cylindrical tube is provided, having an internal lining of insulating material. It is charged with a mass of granulated carbonaceous material which can be more or less compressed by screwing up metallic end plates, the screwed stems of which pass through end covers of insulating material and engage in forked brackets fixed on an insulating base. The brackets can be electrically connected by inserting metallic plugs between them. The whole set of resistances may be enclosed in a casing.

HELIOGRAPH.—Mr. J. L. Watkins has patented a heliograph. The invention consists entirely in the arrangement for operating and deflecting the signalling mirror. The movement is obtained by a continuation of the axle of the signalling mirror working within a hollow bearing, fitted into a slide rest fixed on the side of the U frame, carrying the mirror frame. The regulating slide is fitted on a solid block with an endless traversing screw fixed in bearings at each end with a suitable knob to turn the screw by. The desired length of stroke is accomplished by a milled-headed screw fixed on the slide, and the tension of the spring is regulated by an eyebolt and travelling set nut.

ELECTROLYSING CHLORIDES.—Mr. W. Spiker has patented a method of electrolysing chlorides, bromides, and iodides. This method consists essentially as follows: The suppression of the polarisation of the chlorine is obtained by the introduction of slaked lime into the anode compartment, which is separated from the cathode compartment by a diaphragm of porous clay. By this way the chlorates are obtained, and by an analogous method the bromates and iodates are obtained. The polarisation of the hydrogen is suppressed by a continuous current of steam or air, or both, blown over the surface of the cathode. A current of the same is passed into the anode and cathode compartments in such a way that an intense motion of the electrolyte is obtained.

STEAM ENGINES.—Mr. D. Purves has patented an invention relating to the construction of cylinders of steam engines. In applying it to a double pressure steam cylinder the outer cylinder terminates at each end in a cylindrical steam chest having internal ports, the steam supply pipe being branched so that the chests form practically the ends of the pipe. The cylinder between these ends is recessed, leaving a cylindrical space between the outer cylinder and the inner lining, which forms the piston cylinder and slide valve, which is caused to travel over the steam ports of the chests. These are similar to those employed in ordinary slide valves, the inner cylinder having ports corresponding with those in the chests, and when it is suitably moved they open into the cylindrical space between the cylinders and thence to the exhaust.

ELECTRICAL PROPULSION.—Mr. F. Wynne has patented an apparatus to be employed in applying electricity to propel vehicles. In order that the armature of each contact maker may act in a stronger and more certain manner than heretofore, it is caused to be polarised, when its attracting core of magnetic material is polarised. This is effected by winding the armature with a solenoid that may be in electrical connection with the solenoid that polarises its attracting core, and with the auxiliary electric conductor which is electrically connected with the latter solenoid, and is placed in connection with the main conductor by a contact maker in rear. Flexible connecting wires are used to permit movement of the armature. The coil surrounding the armature is provided with an exposed contact placed in electrical connection with the main conductor when the contact maker is closed. This connection is effected by a contact strip carried by the adjacent end of a forward auxiliary conductor.

ANNOUNCEMENTS.

ROYAL INSTITUTION.—The following are the lecture arrangements before Easter:—Professor Dewar, six lectures (adapted to a juvenile auditory) on Clouds and Cloudland; Professor G. J. Romanes, twelve lectures constituting the second part of a course on Before and After Darwin (The Evidences of Organic Evolution and the Theory of Natural Selection); Professor J. W. Judd, four lectures on The Metamorphoses of Minerals; Dr. Sidney Martin, four lectures on the Poisonous Action of Albuminoid Bodies, including those formed in Digestion; Professor J. H. Middleton, four lectures on Houses and their Decoration, from the Classical to the Mediæval Period; Professor Ernst Pauer, four lectures on The Characters of the Great Composers and the Characteristics of their Works (with illustrations on the pianoforte); and eight lectures by the Right Hon. Lord Rayleigh on Experimental Optics (Polarisation, the Wave Theory). The Friday evening meetings will begin on January 25th, when a discourse will be given by Professor G. H. Darwin; succeeding discourses will probably be given by Professor W. C. McIntosh, Sir William Thomson, Professor A. W. Rucker, Mr. Harold Crichton Browne, Professor Oliver Lodge, Professor Archibald Geikie, the Rev. Alfred Ainger, the Right Hon. Lord Rayleigh, and other gentlemen.

SELECTED BOOKS.

Elementary Commercial Geography. A Sketch of the Commodities and Countries of the World. By H. R. Mill, F.R.S.E., Lecturer on Commercial Geography in the Heriot Watt College, Edinburgh. London: C. J. Clay and Sons. Price 1s.

On the Senses, Instincts, and Intelligence of Animals. With Special Reference to Insects. By Sir John Lubbock, Bart., M.P. With 100 illustrations. London: Kegan Paul, Trench, and Co. Price 5s.

DIARY FOR NEXT WEEK.

Monday, Dec. 10.—Society of Engineers, 9, Victoria Chambers, Westminster, at 7.30 p.m. — *Annual General Meeting.*
Society of Arts, John Street, Adelphi, Cantor Lecture, at 8 p.m.—*Light and Colour*, by Captain W. de W. Abney, C.B., F.R.S.

Tuesday, Dec. 11.—Institution of Civil Engineers, 25, George Street, Westminster, at 8 p.m.—*The Influence of Chemical Composition on the Strength of Bessemer Steel Tires*, by J. Oliver Arnold, F.C.S.

Wednesday, Dec. 12.—Society of Engineers, Guildhall Tavern, Gresham Street, at 6 30 p.m.—*Annual Dinner.* St. James's Hall, at 8.30 p.m. —*Lecture on Architecture*, by Messrs. G. A. T. Middleton and Cecil Orr.
Society of Arts, John Street, Adelphi, at 8 p.m.—*Explosives*, by Mr. W. H. Deering, F.C.S.

Thursday, Dec. 13.—Society of Telegraph Engineers and Electricians, 25, Great George Street, Westminster, at 8 p.m.—*Annual General Meeting.*
London Mathematical Society at 8 p.m.—*A Method of Transformation, with the aid of Congruences of a Particular Type*, by J. Brill.—*The Equilibrium of a Thin Elastic Spherical Bowl*, by A. E. H. Love.

Friday, Dec. 14.—Institution of Civil Engineers, 25, George Street, Westminster. Students' Meeting, at 7.30 p.m.—*The 26-Knot Spanish Torpedo Boat, Ariete*, by Mr. Julian King-Salter, Stud. Inst. C.E.

METEOROLOGICAL RETURNS

for the ten weeks ending on Monday, Nov. 26th, 1888. Specially prepared for SCIENTIFIC NEWS from official reports.

	Mean Temperature.	Rainfall.	Duration of Sunshine.
Scotland, East	45·8 degs., being 2·1 degs. above average.	7·0 ins., being 0·4 ins. below average.	139 hrs., being 50 hrs. below average
England, N.E.	47·1 ,, ,, 0·6 ,, ,, ,,	4·3 ,, ,, 2·2 ,, ,, ,,	162 ,, ,, 11 ,, ,, ,,
England, East	47·7 ,, ,, 0·4 ,, below ,,	4·3 ,, ,, 2·1 ,, ,, ,,	220 ,, ,, 7 ,, above ,,
Midlands ...	47·0 ,, ,, 0·1 ,, ,, ,,	5·6 ,, ,, 1·2 ,, ,, ,,	181 ,, ,, 14 ,, below ,,
England, South	49·5 ,, ,, 0·5 ,, above ,,	6·6 ,, ,, 0·4 ,, ,, ,,	210 ,, ,, 6 ,, above ,,
Scotland, West	47·4 ,, ,, 0·9 ,, ,, ,,	10·5 ,, ,, 0·8 ,, ,, ,,	143 ,, ,, 30 ,, below ,,
England, N.W.	48·1 ,, ,, 0·2 ,, below ,,	7·6 ,, ,, 1·5 ,, ,, ,,	166 ,, ,, 5 ,, ,, ,,
England, S.W.	50·1 ,, ,, 0·4 ,, above ,,	9·4 ,, ,, 1·4 ,, ,, ,,	206 ,, ,, 7 ,, ,, ,,
Ireland, North	49·1 ,, ,, 1·3 ,, ,, ,,	6·5 ,, ,, 1·9 ,, ,, ,,	145 ,, ,, 32 ,, ,, ,,
Ireland, South	50·0 ,, ,, 1·0 ,, ,, ,,	7·1 ,, ,, 1·6 ,, ,, ,,	175 ,, ,, 38 ,, ,, ,,
The Kingdom...	48·2 ,, ,, 0·6 ,, ,, ,,	6·9 ,, ,, 1·5 ,, ,, ,,	175 ,, ,, 17 ,, ,, ,,

The above period is the first this year wherein for ten weeks the mean temperature of the kingdom has been above the normal. The distribution of rainfall has become more than usually unequal.

Scientific News

FOR GENERAL READERS.

Vol. II. DECEMBER 14, 1888. No. 24.

CONTENTS.

SCIENTIFIC TABLE TALK.

By W. Mattieu Williams, F.R.A.S., F.C.S.

A great deal of ingenuity has been expended on theories that have struggled with the question of the origin of petroleum. To those who, like myself, have been engaged in the manufacture of petroleum, have produced it in tons and hundreds of tons, all this learned discussion appears very crooked and far-fetched. We know that if certain kinds of coal are enclosed in any kind of surrounding, such as an iron, or clay, or brick retort, and if this is heated moderately and *slowly*, the slower and more moderately the better, we obtain liquid hydrocarbons not merely similar to the petroleum of the natural springs, but actually the same; that we obtain gases and vapours identical with those that escape from such springs, and we find left behind in our retorts a material identical in chemical composition with anthracite. Its mechanical structure is not quite the same; it is more porous; but if this porous coke be subjected to such pressure as that to which anthracite certainly has been subjected it becomes anthracite.

The simple inference, therefore, is that certain beds of bituminous coal have been heated moderately and slowly, and thus their volatile constituents have been driven from them, as from that in our retorts, and that the non-volatile coke has been left behind, as in our retorts, and this having been subjected to the pressure of the superincumbent strata, has acquired the form of compressed coke, or anthracite.

In controversion of this very simple view, we are told that petroleum is not found associated with coal, but that the springs occur in Silurian, Devonian, Cretaceous, and other non-coal-bearing regions. This presents no difficulty to the oil-maker, who is accustomed to attach pipes to his retorts, and carry the oil vapour to condensers, and the liquid oil from them to considerable distances from his coke. He knows that if his retorts were porous and imbedded in other porous material the vapours would penetrate that material, and there become condensed when it reached a cooler stratum, and that after condensation the liquid would flow downwards, until it reached the limits of the porous material, and that it would there accumulate.

These are exactly the conditions under which many coal-seams have been converted into anthracite. That such conversion has taken place is proved by the fact that there are seams from which the hydro-carbons have been distilled at one end, that end being converted into complete anthracite, the other end of the same unbroken coal remaining highly bituminous, and the intermediate portions forming a gradation due to varying degrees of coking. Mr. Hull (describing the Russian coal-fields) says, "It is a most remarkable circumstance, in connection with the Donetz formation, that the same beds of coal, from being highly bituminous in the western parts of this coal-field, pass by imperceptible gradations into anthracite in the eastern parts, in a manner analogous to that of the South Wales coal-field in our own country."

We know how water-springs are formed, and we are justified in supposing that petroleum springs are similarly formed. As a striking and typical example of a water-spring, I will take that of the celebrated St. Winifred's Well, which has given its name to Holywell, in Flintshire. Here, at a place that is otherwise not more watery than the country generally, a stream of water flows upwards from the ground, pouring forth the enormous quantity of 21 tons, or 4,700 gallons, per minute, equal to a daily supply of 6,768,000 gallons. This forms a small river that runs down to the estuary of the Dee. Why does the water issue there? The answer is very simple. The porous carboniferous strata and the millstone grit of the neighbourhood both slope downwards towards Holywell; there they terminate in a fault which presents to them a wall of compact limestone, and thus the underground flow is suddenly arrested; but its sources being much higher than the place of sudden arrest it, rises to the surface there, and then overflows. Before doing this some of the water has travelled many miles underground.

If water can thus flow through the coal-measure rocks and the millstone grit below them in Flintshire, why should not the liquid distillate from heated coal do the same in these identical rocks at other places? and why should it not accumulate when it meets a barrier of impervious limestone? As a matter of fact, the richest oil-wells like the richest water-springs, do actually occur where porous strata encounter compact rocks, usually limestone rocks.

A little reflection will show that the demand of those who say that if petroleum was formed from coal it should be found associated with it is one that asks for a physical impossibility. All who have had to do with coal-mining know, to their cost, that the rocks both above and immediately below ordinary coal-seams are freely permeable by liquids, as their pumping machinery and pit-tubbing proves, and therefore any liquid hydro-carbon that may have been formed in heated carboniferous strata in times far distant must have percolated far away from the seat of its origin, must have travelled as far as the porous rocks extend, even though that be hundreds or even thousands of miles distant. This would especially occur where the coal-bearing strata were covered with compact rocks of later formation, not permitting surface water to reach them, and such has been the case and is the case with those deeper coal-bearing strata that by reason of their depth must be heated.

Reflecting a little further on these facts, we may arrive at a very consolatory economical conclusion. It is well known that there is much coal far below human reach, the chief impediment to working it being the steadily increasing heat of the earth as we proceed downwards. If I am right in the above we may not lose all that fuel; the coke may remain hopelessly buried, but the hydrocarbons distilled by the heat into vapours will force their way, in gaseous condition, through the heated rocks, very slowly, but not less surely, until they come to cooler strata, then they will condense and accumulate where their further progress is barred by compact rocks, and thus their richest constituents, the hydrocarbons, may be utilised by man as gas-wells and oil-wells, such as abound in Pennsylvania, such as pour up from the sea-bottom on the Californian coast, such as have been running to waste for thousands of years into the Caspian, and such as have formed the great paraffin-pitch deposits of Trinidad.

It should be noted that limestone rocks are specially addicted to cavern formation, owing to their solubility in water charged with carbonic acid, that in some places these caverns extend for miles as tunnels, through which subterranean rivers flow, and in which subterranean reservoirs are standing. The phenomena displayed on boring into the American oil-wells indicate the existence of similar reservoirs of oil in the limestone rocks, oil that has probably found its way there through fissures.

In reference to the theory of animal origin of petroleum, I cannot refrain from reminding its advocates that their objection to the theory above advocated, based on the non-existence of oil with coal, applies to their own theory, as the quantity of animal matter demanded vastly exceeds that of the few fossils found in the oil regions.

Besides this, it should be understood that while petroleum has the same composition as the paraffin distillates obtained by slowly heating certain kinds of coal, both crude petroleum and the solid paraffin wax it contains in solution are widely different, both in composition and properties, from the adipocere which is supposed to be the animal basis of petroleum. Adipocere is a complex soap; Chevreul found it to be composed of a large quantity, of margaric acid and a small quantity of oleic acid, combined with ammonia, potash, and lime. Fourcroy describes it as an ammoniacal soap. Petroleum contains neither of these substances, but a series of special hydrocarbons of the marsh-gas series, *i.e.*, of the products of vegetable composition. Adipocere is readily decomposed by atmospheric and other chemical agencies. Paraffin derives it name (parum affinis) from the stability due to its chemical apathy.

It is a mistake to state that no petroleum is found associated with coal. I visited a coal-mine in Shropshire, known as the "tarry pit," where it ran down the sides of the shaft and filled the "sumph" below. A publican in South Staffordshire found a gas-jet, like those of Pennsylvania, in his cellar, lighted it, and sold much beer in consequence to curious visitors. But for reasons above stated the accumulation of large quantities is impossible in such places.

ASTRONOMY IN CHINA: THE PEKIN OBSERVATORY.

VICE-ADMIRAL MOUCHEZ has just received from Pekin, for the Astronomical Museum which he has founded in connection with the Observatory of Paris a series of photographs representing the Pekin Observatory and the instruments there erected. By the courtesy of our contemporary *La Nature* we are enabled to place these curious views before our readers, and thus give them an exact idea of the present state of astronomy in the nation which has cultivated it with the greatest zeal, for the longest time, and among whom it has received the most remarkable developments.

Astronomical functions have not ceased to be held in honour in China, and the Observatory of the Celestial Empire is at present under the direction of an uncle of the Emperor, who ranks as the fifth prince of the blood, and bears the title of Chancellor.

The number of persons attached to this establishment is more considerable than that at Paris. It amounts, including students, to 196. The chief functionaries after the Chancellor are a Chinese director and a Tartar director, having the right to wear a button of a precious stone, and to bear on the chest the image of a sea-raven. Then follow two sub-directors, one Chinese and one Tartar, and two assistants entrusted with calculations. These latter, prior to the expulsion of the Jesuits, were always foreigners. Two other functionaries require to be noted. The first is the keeper of the buildings, and the second the custodian of the water-clocks, as chronometers have not been as yet introduced into the observatory, any more than have telescopes.

The calculators of the Observatory possess tables constructed or rectified by the Jesuits in the seventeenth century, which are used in their calculations, and which they keep carefully hidden. Hence, contrary to the general principles of the Chinese Government, the astronomical functions have become hereditary. But on the other hand, they are purely honorary.

The strictly scientific functions are not very difficult to execute, since in Pekin itself there are some private observatories attached to the European embassies. Besides, the missionaries have organised at Zi-ka-wei an observatory of the first rank, where all the modern methods are carried out with carefully selected instruments. This establishment is situate at 800 kilometres to the south-east of Pekin, in the neighbourhood of Shanghai. The astronomers of the Chinese Government can thus, with little trouble, carry on the conversion of the calculations.

But they have also to discharge a more delicate function, in which they cannot be assisted by European *savants*. This is to determine the lucky and unlucky days, an operation of the greatest importance in a country where a faith in astrology is universal. They have, besides, like the ancient Augurs of Rome, to consult omens, which they do in a manner showing great simplicity.

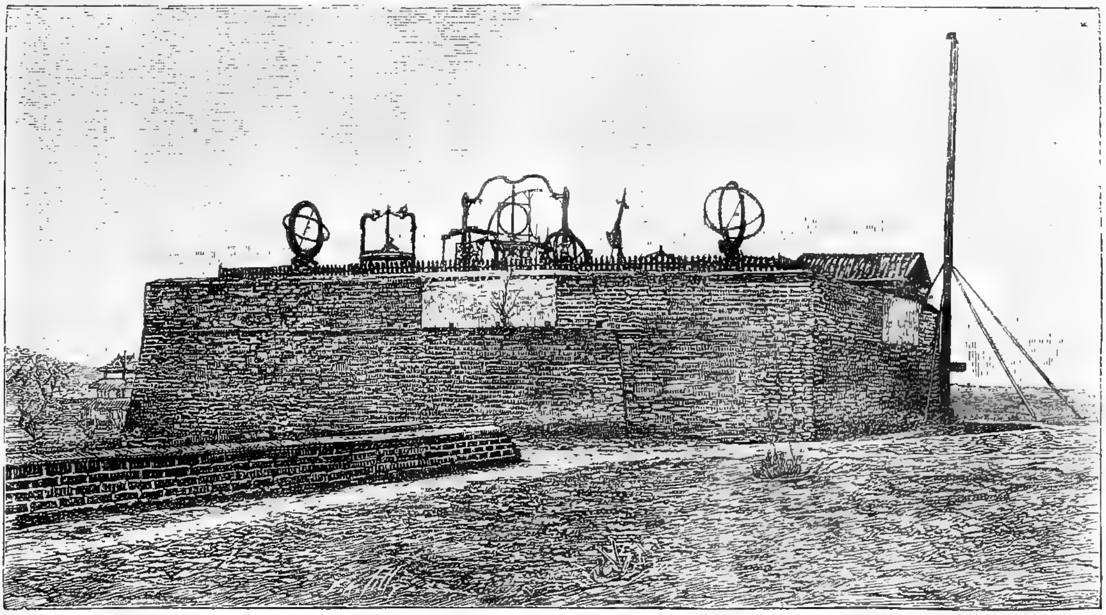


FIG. 1.—GENERAL VIEW OF THE OBSERVATORY.

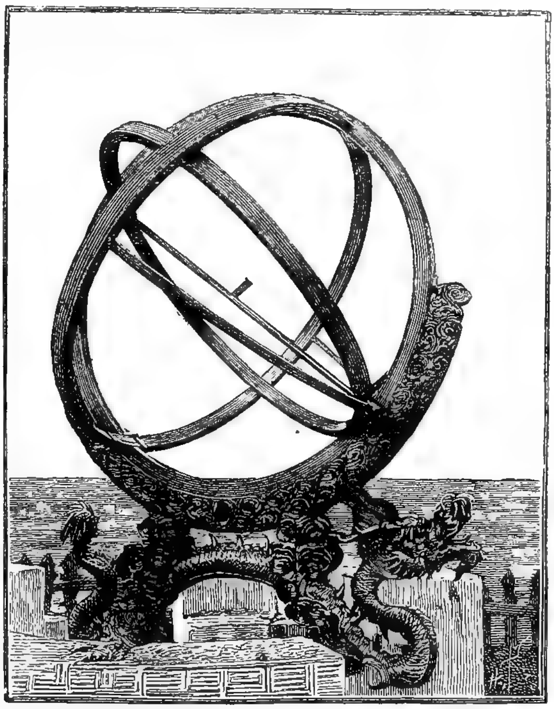


FIG. 2.—BRONZE ARMILLARY SPHERE, SUPPORTED BY DRAGON MADE IN THE SEVENTEENTH CENTURY.

The council of the Observatory of Pekin meets in full conclave on the evening of the last day of the year, and remains sitting until midnight, when the new year begins. At this moment the astronomers look from what quarter the wind blows, which they ascertain by means of sacred banners set up for the purpose. On February 14th, 1888, at the beginning of the twenty-fifth year of the seventy-sixth cycle, which is not yet completed, they ascertained that the wind was north-east, a point considered as the most favourable omen. They drew hence the conclusion that all kinds of felicity might be expected during the next twelve months.

The observatory is placed on a terrace of some yards in height, and of a square form, situated along the fortifications of Pekin. It is traversed by a tunnel, through which passes the road, and in case of need it could be utilised for the defence of the city.

Our figure No. 1 shows this terrace with the collection of instruments which the Chinese astronomers use, or are supposed to use, in their observations. The other figures show in detail the manner in which they are constructed. Fig. 2 gives an idea of the luxury and art with which some of the instruments are mounted.

Father Lecomte, who had to manage these instruments at the end of the seventeenth century, says that the workmen who executed them had been much more concerned with the perfection of the figures of dragons with flames issuing from their throats than with the accuracy of the graduations. He thinks that a quadrant of eighteen inches executed at Paris by the opticians of his time would give more useful results than the great six-foot circle executed at Pekin. The limb is divided into graduations of ten minutes, which is the limit of accuracy attainable if the graduation had been carefully executed, and if the instrument had been fitted with sights.

Father Lecomte describes the installation of a quadrant of a very careful construction, probably the one which Louis XIV. sent to the Emperor Kang-hi.

The lead which marks its vertical position weighs a pound, and hangs from the centre by means of a delicate copper wire. The index is movable and slides freely on the limb. A dragon, coiled up and surrounded with clouds, comes from every side to seize the bands of the instrument, lest they might move out of their plane. The entire body of the quadrant is in the air, traversed by the centre of an immovable axle, upon which it turns towards those parts of the heavens which are to be observed. Because its weight might cause some oscillation, or cause it to leave its perpendicular position, two shafts are placed at the sides. They are secured at the bottom by two dragons, and connected to the middle shaft by clouds which seem to descend from the air.

(To be continued.)

EXAMINATIONISM.

THE *Medical Press and Circular* writes:—It has for years been painfully evident that the effect of the examination mania on education is not productive of the good that had been anticipated. The great vice of examinations as at present conducted, is that a strain is put on one department of the memory to the quasi-exclusion of others. The acquisition of facts is an essential part of general training, but it is, after all, only a means to the end, the end being to furnish the reasoning powers with the requisite data to proceed upon. To be available, facts require to be thoroughly assimilated, so that they can be perceived at the same time. This perception is the basis of judgment and so-called experience. If the mind be over-weighted with ill-assimilated facts, the reasoning powers are unable to act to the best advantage, and become stagnant. The amount of acquired knowledge that can be utilised in a given time varies considerably in different persons. It is as with food; what will suffice to give one man an indigestion, will only make another one feel comfortable. The analogy, indeed, can be pushed a good deal further without overstraining. The same food will not suit every stomach, so success should reward, not the ingestion of the largest amount of food, but the utilisation thereof."

So far so good; but our contemporary adds, "The difficulty is of course in estimating the latter, and until the adversaries of examinations succeed in finding a means of measuring *assimilation*, the present system, with all its drawbacks, will perforce continue."

This is a somewhat lame and impotent conclusion. In some departments means of testing *assimilation* are already known. In almost every science the production of original work is proof positive that the student has assimilated the instructions given, and he ought, therefore, to be spared the superfluity of examination in that science.

There exists also a test better than examination in the case of candidates seeking to rise from a lower to a higher grade, *e.g.*, in the choice of surgeon-major or surgeon-general in the army. Let the aspirant be judged *rebus gestis*, by his practical results, by the skill and attendant success which he has already shown in the discharge of his duties. In fact, we may say that if it once becomes known that officialism is willing to admit that examinations are of very doubtful efficacy, suggestions for a better method of selection will not be lacking.

THE UTILITY OF BEES.

AS the benefits derived by man from bees are by no means fully understood, we take the opportunity of laying before our readers certain results observed on the Continent, and which have been in part published in *La Nature*. M. Eugène Jobard, editor of the Lyons paper, *Le Bien Public*, has recently published a very important work on this subject.

He does not lay the greatest weight on the direct products of the hive-bee, the honey, and the wax, although these have a considerable commercial importance, but on the part played by the bees in the fecundation of fruits, vegetables, cereals, and the natural and artificial grasses. A study of their activity in this respect enables him to declare that rational bee-keeping would revolutionise agriculture by doubling the production of vegetables and fruits.

In Saxony, he tells us, there are districts where the farmers grow nothing but seed-wheat, which they sell at a high price. All these farmers possess hives which, instead of being fixed, are installed upon little carts, and at the moment when the wheat is in flower, each farmer removes his movable hive to the midst of his wheat fields.

When the fact was mentioned one day at Velars in presence of several farmers, one of them exclaimed, "This is the reason why my finest wheat is always that which I reap near my hive."

A similar declaration was made some time after by the Mayor of Lanques, an extensive farmer of Haute Marne. He says, "As I intended, I have sown with wheat all the fields near my hive. This year, as heretofore, the grain from these fields is incontestably superior to that of all the neighbouring land. The ears are stouter, better filled, and this year again I shall select this wheat for seed.

"But further, the ears in the fields nearest to my apiary are finer and heavier than those in the rest of the district."

As to the fecundation of fruit trees, the question is proved by an assortment of facts which leave no room for doubt. For instance, the clergyman of Ninville (Haute Marne) introduced some hives in 1883 in his garden, where, during twenty years, some thirty fruit trees, in spite of his intelligent care, had borne no fruit. But after the introduction of the bees, pears and apples abounded on the trees which had hitherto been regarded as barren.

Mr. Jobard cites an observation made by Darwin, which will doubtless be familiar to many of our readers. He made very remarkable observations on the fecundation of plants by bees, which he repeated yearly, and always with the same results. Near his bee-hive he sowed colza and white clover, and when the plants were about to flower he covered some of the heads with light gauze, and thus protected them from the action of bees. When the seeds were ripe, he took both from the plants thus protected and from those which had been visited by the bees the same number of seed-heads and counted the seeds. The balance in favour of the plants fecundated by bees was on the average 50 to 60 per cent., and moreover the individual seeds were much finer than those of the covered plants.

In clover there occurred, besides, a remarkable phenomenon. The clover fecundated by the intervention of bees always grows larger than that sheltered from them. Hence Darwin drew the conclusion that this remarkable development of the plant was due to the constant suction effected by the bees in the corollæ, in which the honey is incessantly renewed. If the plant is not sufficiently emptied there occurs a congestion and an arrest of development. What confirms this observation is that of two tufts of clover flourishing together, one covered and the other open, the latter continued to grow, whilst that excluded from contact with the bees became stationary as soon as its flowers were expanded.

The neglect of apiculture, says M. Jobard, is one of the greatest errors committed by farmers, and this neglect is most general in France.

In Austria, Germany, Italy, Hungary, in Russia and the United States apiculture is encouraged in an especial manner. In Alsace-Lorraine the German Government subsidises very liberally two apicultural papers, which have been established since the annexation of the provinces.

At Vienna there is even an Apicultural Academy, under the presidency of the Emperor.

If we talk about bees to one of our great agriculturists he will reply that his time is too precious to be spent on such trifles. The eminent agriculturist who allows himself to be beaten on his own ground by foreign nations is not aware that there exist in America at least thirty financial companies, each possessing a capital of five to six millions (dollars or francs?) which they employ in—what? In spreading hives over the American territory. The Americans have been the first to act upon the discovery that bees are essential to the successful fecundation of plants. They are aware that from them alone may be obtained thousands of tons of sugar which nature has distributed so freely.

M. Jobard further informs us that with honey the strength of wines may be raised, and that wines thus treated acquire a delicacy not otherwise to be obtained.

(To be continued.)

SOME RECENTLY DISCOVERED FORMS OF MICROSCOPIC CRUSTACEA.

(*Part I., continued from p.* 574.)

Cymbasoma herdmani, I.C.T., plate iii. One specimen only of this very remarkable species was recently taken between Anglesea and Puffin Island, and it has since been recorded from Jersey.

Length 1-10th inch, the cephalothorax is nearly the same width throughout, is truncated at each end and five-jointed, the first joint being nearly equal in length to the remaining four. The anterior antennæ of male (fig. 2)

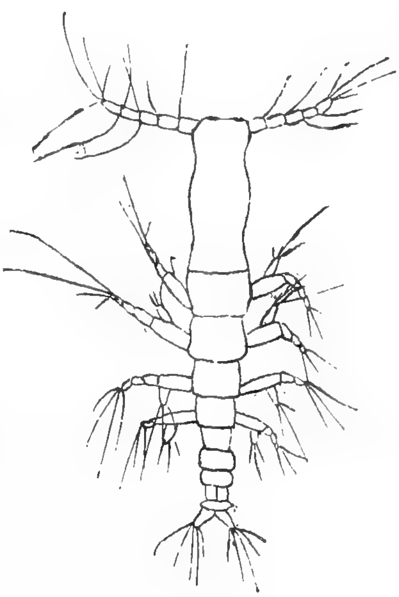


Fig. 1.

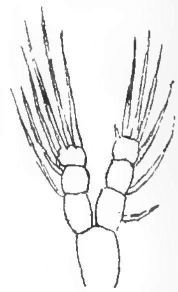


Fig. 3.

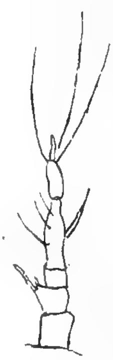


Fig. 2.

Cymbasoma Herdmani, I.C.T., figs. 1-3.

Fig. 1. *Cymbasoma herdmani*, I.C.T., male, 150
Fig. 2. Anterior antenna of do. 250
Fig. 3. One of swimming feet of do. 250

are five-jointed, strong and muscular, the fourth joint being nearly equal in length to the preceding three; there is a hinged joint between the fourth and terminal. There are several spines and setæ throughout the antennæ, the apex bearing a terminal claw. The first four pairs of swimming feet are alike in structure (fig. 3), the basal joint being very large. Both branches are three-jointed, and clothed with strong spinose setæ. The abdomen of the male is five-jointed, gradually getting smaller, the fifth being wedge-shaped laterally. The caudal segments are divergent and stumpy, a little longer than broad, each terminated by six spinose setæ.

The only hitherto known species of this genus, *C. rigidum*, Thompson,* was taken by tow-net off Teneriffe.

The total number of species of free-swimming Cope-

* Described in a paper read before Linnæan Soc., London, Lin. Jl. vol. xx., 119.

poda known to Britain amount to about one hundred and seventy. Of these about twenty-five are inhabitants of fresh water, the rest being marine, with the exception of a few species whose habitat is almost entirely brackish water.

But in addition to these are a considerable number of parasitic and semi-parasitic Copepoda. The former are found attached to fishes, annelids, various crustacea, and more especially to the compound ascidians, where they subsist on the juices of their amiable hosts, apparently causing little, if any, inconvenience to them. Many of the semi-parasitic species appear at times to leave their hosts and wander on their own account through the water, but they are comparatively rare, and usually found in tow-nettings taken after sundown or during the night.

ANIMAL GEOGRAPHY.

MOST of our readers have, doubtless, a general acquaintance with the view propounded by Dr. P. L. Sclater, and elaborated by A. R. Wallace in his great work the "Geographical Distribution of Animals." These authorities admit six main regions—the Palæarctic, the Ethiopian, the Oriental, the Australian, the Nearctic, and the Neotropical—and they base their arrangement mainly on a consideration of the mammalia, endeavouring to harmonise the boundaries thence deduced with the distribution of other animals.

Mr. J. A. Allen—not to be confounded with Mr. Grant Allen—proposes eight "realms"—the Arctic, the North Temperate, the American Tropical, the Indo-African Tropical, the South American Tropical, the African Temperate, the Australian, and the Antarctic. Other classifications, obviously of less merit, we cannot here mention.

Dr. A. Reichenow, in a recent very elaborate memoir, an abridgment of which appears in *Humboldt*, recognises in the first place an Arctic "Zone" extending from the north pole southwards to the utmost border of the forests alike in the eastern or western continents. Reichenow's Arctic Zone, therefore, includes the most northern portions of the Palæarctic and Nearctic regions of Sclater and Wallace. The whole of America, from the northern boundary of the forests southwards to Cape Horn, is characterised as the Western Zone, and corresponds to the whole of the Neotropical of Sclater and all his Nearctic region south of the forest limit. In justification of this arrangement Reichenow contends that the birds of North America have a decidedly South American character, and have had their "centre of creation or origin" in the latter continent.

In the eastern hemisphere we find greater complexity. The temperate portion of Europe-Asia extends over 180° of longitude, and its southern boundary is more or less closely connected with several parts of the globe situate in the tropics, but distinct from each other. Thus the immigration into the temperate regions has taken place, in his opinion, not from one centre, as in America, but from several. Like Allen, Reichenow concludes that the Malayan (Oriental of Sclater and Wallace) cannot be regarded as of equal value with the former, but must be combined with Africa to form a great territory, the Ethiopian-Malay region, whilst, on the other hand, Madagascar has a peculiar and independent fauna. Besides these two regions, we have in the eastern tropics only a third, that of Australia. Immigration into temperate Europe and Asia might have taken place from any of these three faunal territories. But in fact we find that the Eastern Temperate bird fauna has no relation to the Australian and the Madagascar fauna, but has a predominating Ethiopian-Malay character. Hence, ornithologically speaking, Europe and Asia must be combined with the Ethiopian-Malay regions to form the Eastern Zone, comprising accordingly the Palæarctic region of Sclater and Wallace from the northern limit of the forests, the Ethiopian and the Oriental regions as far as "Wallace's line." This zone is divided into three regions (a "region" in Reichenow's system corresponds to a "sub-region" in that of Sclater and Wallace). The Eastern Temperate region comprises Europe from the above-mentioned tree limit, North Africa to the Senegal and further east to 15° north latitude, Arabia except the southern coast, Asia from the tree limit to the Himalaya range and its eastern and western extensions, and the Japanese Islands.

The Ethiopian region includes Africa from the Senegal and the 15th degree of north latitude southwards, the south coast of Arabia, Socotra, the West African Islands, and St. Helena.

To the Malay region belong India and South China, the Sunda Islands, including Borneo and Java, Formosa, the Philippines, and the Chagos Islands.

The Madagascar and Australian faunal territories, though, of course, so far smaller, are considered equal in rank to the Western and the Eastern Zones, and are characterised as the Madagascar and the Southern Zones. The former admits of no subdivision; it includes, besides Madagascar, the Mascarenes, Comoros, and the Seychelles.

The Southern Zone resolves itself into two regions; the one of these, the Australian, includes Australia proper, Tasmania, New Guinea, the Malay Islands to the east of Wallace's line, including Celebes, Lombok, and the Moluccas, and the Polynesian Islands. The New Zealand region comprises, in addition to New Zealand, the Chatham, Auckland, Campbell, and Macquarie groups and Norfolk Island.

As the sixth and last primary division comes the Antarctic Zone, comprehending the south polar islands. These latter do not, as it might have been expected, show any connection with the nearest continents, but have a striking similarity among themselves. Thus of thirty species of birds which nest in Kerguelen's Land and South Georgia, islands far remote from each other, the half is common to both. The chief islands belonging to the Antarctic Zone are South Georgia, Prince Edward's, Crozet, Kerguelen, Macdonald's Islands, St. Paul's, and North Amsterdam.

Having thus expounded, without by any means advocating, Dr. Reichenow's system, we must point out that it differs less from that of Sclater and Wallace in the boundaries of the respective faunal territories than in the rank which it assigns them. The Australian and Oriental districts retain precisely their former boundaries, but the latter is reduced from the rank of a primary to that of a secondary division. On the contrary, Madagascar rises to the first rank.

The author, we think, scarcely pays due heed to the palæontological evidence, which is certainly less abundant in case of birds than among mammals and reptiles. By going back only, as it appears, to the close of the Glacial epoch, he is enabled to speak of the immigration of tropical forms into temperate Europe and America, and thus to introduce the notion, delusive as it seems to us, of centres of creation or origin, a theory devised in France to weaken, if possible, the evidences of evolution.

General Notes.

Cutch and Gambier.—H. Trimble, in the *American Journal of Pharmacy*, controverts the common notion that cutch and gambier are identical in composition.

Blindness in Russia.—Of the cases of blindness in Russia, which are said to be more abundant among the Finnish-Mongolian races than among those of Aryan or Semitic origin, one-eighth are due to smallpox, and one-half only to direct disease of the eye.

Rats and Electric Lighting.—M. Helbig, of Rome, writes to *La Nature* that the electric lighting in that city had been interrupted in a very curious manner. A rat, in passing over a commutator, formed a short circuit, thereon the cut-outs immediately melted.

A New Microscopical Society.—A microscopical society is in the course of organisation at Edinburgh, and it seems likely to begin operations under favourable auspices. Curiously enough, a resolution was carried declaring ladies ineligible for membership.

Prevalence of Rickets in Sheffield.—Dr. C. V. Gwynne says that few towns in the empire can compete with Sheffield in the production of rickets, and to this it is in no small extent due that the inhabitants possess the smallest physical type of any large town in the kingdom.

The Proposed Zoological Garden at Washington.—It is painful to learn from the *American Naturalist* that the proposed Government Zoological Garden at Washington has been rejected on the plea of economy. This in the case of a Government which is at a loss how to spend its surplus.

Rain in Egypt in 1888.—In the memory of man, says *La Nature*, no rain has fallen in Egypt in the month of June. This year on June 3rd the following quantities have fallen and have been duly measured: at Alexandria 0·2 millimetre, at Cairo 1·15, at Port Said 5·6, and at Suez 1·0 millimetre.

The Arrest of Civilisation in China.—Miss Adele M. Fielde (*Popular Science Monthly*) ascribes the arrest of Chinese civilisation in part to the peculiar marriage customs of that country, in virtue of which "sexual selection" is rendered inoperative, as the contracting parties have before espousal no opportunity to judge of the strength, beauty, and intelligence of their consorts.

The Survey of the Nicobar Islands.— Colonel Strahan, who has just surveyed this group, reports their total superficies as 618 square miles. The highest summit is 2,105 feet above the sea level. The scenery is said to be of indescribable beauty. Some of the rivers are navigable for boats to a considerable distance. The natives are apparently allied to the Malays; they are of a reddish-brown colour, finely developed, and have a remarkable talent for learning languages.

Colour of Lightning.—In a storm which occurred at Altona in August last, some interesting observations were made on the colour of lightning. Of the ten first flashes three were red, one greenish-red (a peculiar colour), one reddish-blue, one blue, one greenish-blue, and three doubtful. Of the ten following there were four red, of the ten next six red, and of the following ten eight red. Of the seven last, three were completely red. In the second part of the storm the number of the red flashes, according to the *Meteorolog Zeitschrift*, was still greater.

The Purity of Gold.—Dr. Cohen (*Naturwissensch Verein fur Neuvorpommern und Rügen*) discusses the arguments on behalf of the chemical theory of the deposition of gold in placers compared with those in favour of its mechanical origin. He shows that some of those urged in favour of the chemical theory are of doubtful existence. Thus it has been stated that placer gold always contains less silver than vein gold from the same region. Analyses of specimens from Buttons Creek, in the South African gold-fields, show that such is not always the case. Thus a sample of vein gold yielded 94·48 per cent. of gold, and 5·16 of silver, whilst two samples of placer gold showed respectively 91·38 and 95·02 of gold, and 6·49 and 4·60 of silver. He thinks that placer gold is mostly derived from the breaking down of gold veins, but that there is occasionally, in addition, a deposition of the metal from its solutions.

The Conditions of the Earth's Interior.—The following considerations put forward in the *American Naturalist*, by Ira Sayles, claim serious attention. It has been held by some authors, that no crust can form over a molten sphere, for, say they, when the surface cools *it is heavier than the molten mass within, and must necessarily sink; so that the centre would become solid first.* (Solid tin floats upon melted tin!) Second, ejected lavas always cool on the surface first, while yet the deeper portions are molten, and continue to flow long after a solid crust has been formed. Thus does direct observation show the falsity of their hypothesis. Third, these authors neglect the fact that the lighter materials lie like a thick blanket around the outside of the sphere, and even though they were to become frozen, they could never sink into the molten heavier matter. Cold iron will not sink in molten gold; cold silicon cannot sink in molten iron. Fourth, these lighter materials are highly non-conductive to heat, and hence husband the internal heat.

Department of Science and Art.—Mr. W. Crookes, F.R.S., has presented to the Department of Science and Art a collection of sixty-eight radiometers and similar instruments for permanent exhibition in the science galleries of the South Kensington Museum. They illustrate the steps by which Mr. Crookes was led to the construction of the radiometer, and to the production of motion and of phosphorescence by streams of electrified molecules in high vacua. Many of the instruments are of the greatest historical interest. Among them is included the first radiometer, with many others which are described in Mr. Crookes's papers in the Philosophical Transactions of the Royal Society. Others are of considerable value, as they contain collections of diamonds, rubies, etc., for the exhibition of the phenomena of phosphorescence. Nearly all are in working order, and will be of great use in illustrating lectures to students in the Normal School of Science at South Kensington. The collection will be on view in the galleries of the Museum in Queen's Gate as soon as the necessary stands and sittings are completed.

Interesting Fossil Remains.—Mr. R. Etheridge has recently examined a small collection of fossil bones found by Mr. A. S. Cotter, of Cainwarra Station, Paroo River, New South Wales, in sinking a well at Thorbindah, near that place. He states that they consist chiefly of those of the kangaroo and the large extinct diprotodon; but amongst them were two bird bones. One of these proves to be the right shank bone of a very large bird, allied to, but distinct from the emu. It exceeded the latter in stature and robustness of limb, and in Australia took the place of the gigantic extinct moas of New Zealand. The first intimation of the existence of such a bird in Australia is due to the late Rev. W. B. Clarke and Mr. Gerard Krefft, who in 1869 referred a thigh bone of a large bird found in a well sinking on the Peak Downs to the moa. This determination, however, was afterwards shown by the veteran osteologist Professor Sir Richard Owen to be only partially correct, and in naming the bone *Dromornis Australis* he showed that it represented a stuthious extinct bird, having more affinity to the emu than to the moa. Since then a left shank bone was sent to Professor Owen from Mount Gambier Ranges, South Australia, and in 1876 a large pelvis was found in the Canadian lead, near Gulgong, both of which are believed by Sir Richard to have belonged to his *Dromornis*. The late discovery is, therefore, a very welcome addition to our knowledge of the extinct Australian avifauna.

Seedlings of Sugar-cane.—The sugar-cane has been cultivated for so long a period that its native country is unknown. Bentham states that "we have no authentic record of any really wild station for the common sugar-cane." Further, according to the *Kew Bulletin* for December, the sugar-cane so rarely produces mature seeds that no one appears to have ever seen them. In botanical works the subject is often mentioned, but apparently only to restate the fact that observers in all countries "have never seen the seeds of the sugar-cane." The authorities at Kew have been working at this subject for several years. It was felt that if a sugar-cane producing ripe seeds could be found a most interesting and important line of inquiry would be opened for improving the saccharine qualities of the sugar-cane, in the same way as that so successfully adopted with regard to the beet. Hitherto the sugar-cane has been reproduced under cultivation solely by means of buds and suckers. The improvement of the cane has therefore been restricted to chance variations occurring at wide intervals, and probably escaping altogether the observation of the planter. Now all this is likely to be changed. It appears that at Barbados seedlings of sugar-canes have been successfully raised by Professor Harrison, and among these seedlings are several different kinds indicating hybridity of a definite sort, such as would be expected to arise from the crossing of different varieties. It is to be hoped this subject will be fully and clearly followed up as a definite field of investigation. In any case the possibility of improving so important and valuable a plant as the sugar-cane possesses general interest.

The Public Health.—The Registrar-General's return for the week ending December 1st shows that the deaths registered during that period in twenty-eight great towns of England and Wales corresponded to an annual rate of 17·8 per 1,000 of their aggregate population, which is estimated at 9,398,273 persons in the middle of this year. The six healthiest places were Hull, Brighton, Nottingham, Leicester, Portsmouth, and Bradford. In London 2,367 births and 1,352 deaths were registered. Allowance made for increase of population, the births were 372 and the deaths 412 below the average numbers in the corresponding weeks of the last ten years. The annual death-rate per 1,000 from all causes, which had been 19·7 and 17·2 in the two preceding weeks, further declined last week to 16·5. During the first nine weeks of the current quarter the death-rate averaged 18·7 per 1,000, and was 1·4 below the mean rate in the corresponding periods of the ten years 1878-87. The 1,352 deaths included 141 from measles, 24 from scarlet fever, 34 from diphtheria, 20 from whooping cough, 11 from enteric fever, 1 from an undefined form of continued fever, 13 from diarrhœa and dysentery, 1 from cholera, and not one from small-pox or from typhus; thus 245 deaths were referred to these diseases, being 22 above the corrected average weekly number. In Greater London 3,068 births and 1,678 deaths were registered, corresponding to annual rates of 29·0 and 15·8 per 1,000 of the estimated population. In the Outer Ring 16 deaths from measles, 7 from diphtheria, and 5 from whooping-cough were registered; 7 fatal cases of measles occurred in West Ham sub-district, and two of diphtheria in Willesden and in Tottenham sub-districts.

Talking Machines.—If the improved phonograph, and its rival the graphophone, never succeed in rising to be more than toys, they will at least have afforded material for several amusing articles in which their possible uses have been discussed. In looking up a subject in the *Mechanics' Magazine* for 1839 we lighted on a letter on "Mechanical Probabilities," by Chas. Thornton Coathupe, from which we extract the following: "Musing over mechanism and mechanies, I thought of Babbage's 'calculating-machine,' and then of the embyro 'talking-instrument,' and felt that a space in mechanics was yet imperfectly explored which, if cultivated, might perchance prove of essential benefit to mankind. Perhaps here I slept, and dreamed; for having conceived our religious doctrines to be of an immutable nature, and that almost every text in our sacred Scriptures had received the fullest expositions of our ablest divines over and over again, and that little more could be advanced which had not been promulgated by voluminous edited publications, I fancied every pulpit had become a 'talking instrument,' and every sermon a steam-engine of very 'small power,' every clergyman a 'barrel' 'pricked' for its text. I thought of the saving to the agriculturists in tithes, and to the more important public in dues, fees, and other taxation, and again felt too happy. I then dreamed of schools for public instruction, in which the master's desk was a steam-engine, the master the 'barrel' 'pricked' either for grammar (English, Latin, or Greek) or for mathematics (pure or mixed). I fancied the usher the engine-man, consuming his rod in 'teasing' the fire, while the boys stood round Babbage's machine with their slates in hand, listening to the explanations from the talking barrel. I fancied I saw barrels representing professors of Oxford and of Cambridge, 'shifting' according to expediency, some branded 'multum in parvo,' intended for the elucidation of four or five branches of natural philosophy, in lieu of so many professors." Can any reader give us further information about the talking-machine referred to?

SIMPLE EXPERIMENTS IN PHYSICS.

As a means of illustration, nothing can excel projection by means of a good optical lantern. Not only can pictures and diagrams be shown clearly to a large assemblage, but apparatus of various kinds may be projected on a mammoth scale; many chemical actions may be exhibited; the phenomena of light, heat, electricity, and magnetism may be shown in various ways. In fact, there is scarcely a branch of physics that may not be illustrated in this way. The lantern is becoming

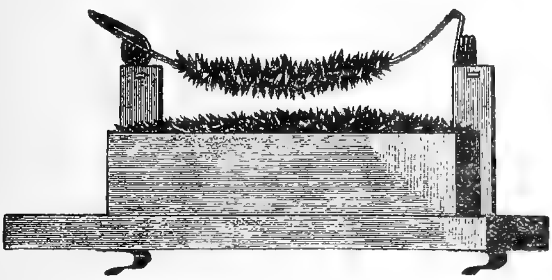


Fig. 1.—Arago's Experiment.

deservedly popular in colleges and schools and for private use. Besides being of great use for general instruction, it affords a means of rational amusement and entertainment. A poor lantern, like any other inferior piece of apparatus, is undesirable. An instrument for scientific work should have a triple condenser, a rectilinear objective, a swinging front for the vertical attachment, a calcium or electric light, polariscopic and microscopic attachments, an erecting prism, and an alum or water tank. Such an instrument may now be pur-

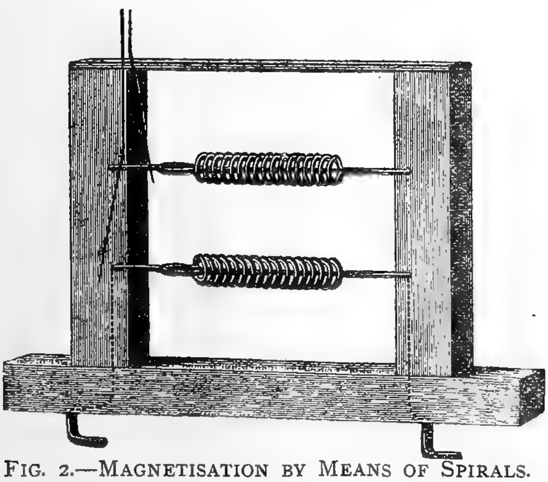


Fig. 2.—Magnetisation by Means of Spirals.

chased for a reasonable price, so that there is no economy in making one's own instrument. It will, however, be found advantageous to make attachments. A simple way of illustrating Arago's experiment, showing the magnetising effect of an electric current on soft iron, is represented in fig. 1. The lantern to which this and other pieces of the apparatus are adapted is provided with two rods, projecting from the front of the instrument and connected with binding posts, which in turn are connected with a battery of dynamo. The base of this apparatus is furnished with spring clips for engaging the conducting-rods of the lantern. To the upper ends of two posts rising from the base are attached the extremities of a copper wire, which is bent into spirals at its fixed ends. The wire is bent twice at right angles, and is curved downwardly between the arms extending from the spirals. The ends of this wire are connected with the clips. On the base below the curved part of the wire is placed a box well filled with iron filings. The box and wire are projected on the screen, an erecting prism being used. The wire is pressed down-

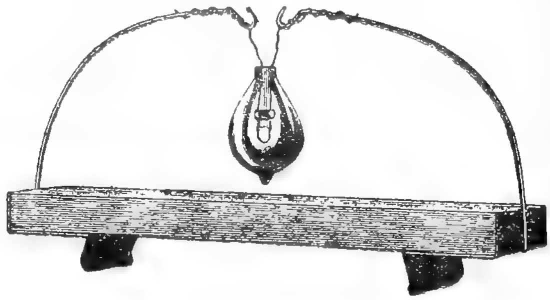


Fig. 4.—Incandescent Lamp arranged for Projection.

ward into the filings, and withdrawn before the current passes, to show that the wire, uninfluenced by the current, is not able to lift the filings. The current is sent through the wire when it is again dipped into the filings. This time it will take up a quantity of the filings, as shown in the engraving, each fragment of iron becoming a magnet, which tends to place itself at right angles to the current. When the current is interrupted the filings fall. In fig. 2 is represented a device for showing the magnetising effect of a helix, also the different

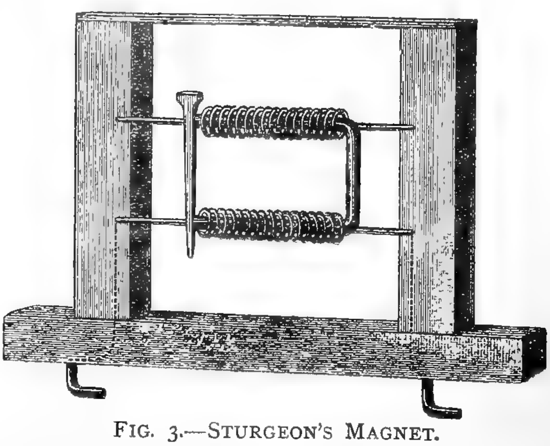


Fig. 3.—Sturgeon's Magnet.

results secured by helices wound in opposite directions. The frame is provided with metal clips for attachment to the rods of the lantern, and two helices which are oppositely wound with respect to each other are stretched across the frame. The ends of the helices are connected with the clips, so that the current passes from one clip through both helices, as indicated by dotted lines, to the other clip. The helices are provided with a coating of insulating varnish. A darning-needle is placed in each helix, and when no current is passing a magnetised cambric needle, suspended by a fine thread, is held near the ends of the needles in alternation. It is drawn toward both alike, and after a current has been sent through the helices it will be found that the darning-needles are magnetic; but owing to the opposite winding of the helices, corresponding ends will have opposite polarity, as will be shown by again presenting the suspended cambric needle to the ends of the darning-needles. It will be attracted by one, and repelled by the other. By placing a U-shaped piece of soft iron wire in the helices, as shown in fig. 3, the construction of the first electro-magnet (Sturgeon's) is clearly illustrated. In fig. 4 is shown a device for projecting the incandescent lamp. It is suspended from two conductors, and its image is thrown upon the screen with a dull light, which is just sufficient to clearly show the outline of the lamp and the black carbon filament. A current is then sent through the lamp, when the filament becomes in-

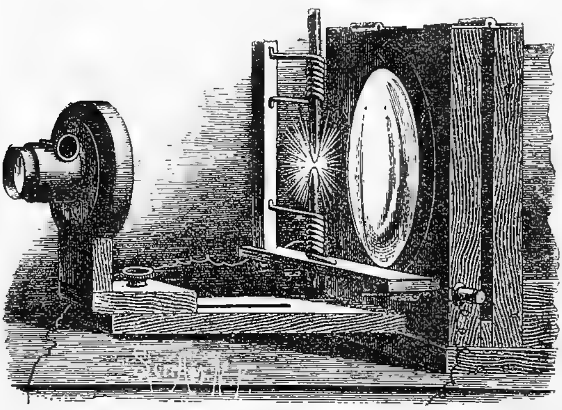


FIG. 5.—PROJECTION OF THE ARC.

candescent, and shows as a brilliant arc on the screen, while all of the parts of the lamp are distinctly visible. In fig. 5 is shown a method of projecting the electric arc, which has the advantage of showing the carbons before the arc is formed, and also of rendering them visible during the experiment. The lamp consists of two wire carbon holders attached to a wooden standard, and connected with the rods of the lantern, as in the cases before described. The carbons are projected with a dim light, showing the crater of the positive carbon and the point of the negative carbon. Then the current is turned on, the carbons are brought in contact and separated, forming the arc, the points soon become incandescent, and the arc light in full operation is seen on a large scale on the screen. These experiments are very striking when seen upon a large screen, the projection of the arc and incandescent lights being particularly interesting.—*Scientific American.*

PORCELAIN SHOT.—Under this name small white globules of porcelain are made in Munich. They are made to take the place of ordinary lead shot used for cleaning wine and medicine bottles, as porcelain is entirely free from the objection of producing lead contamination, which is often the result when ordinary shot is used. Their hardness and rough surface producing when shaken, greater friction, adapt the porcelain shot well for quickly cleaning dirty and greasy bottles, and as they are not acted upon by acids or alkalies, almost any liquid can be used.—*Rundschau; Am. Jour. Pharm.*

ANTIPYRINE IN SEA-SICKNESS.

MANY references to the properties and uses of antipyrine, a coal-tar product, and one of the recent additions to the Pharmacopœia, have been scattered through the daily and weekly journals during the last few months. It has been administered in subcutaneous injections, and recommended as a febrifuge, as well as for neuralgic headache and other ailments, but the most interesting of its numerous applications to the majority is probably its employment against sea-sickness. So many circumstantial details of its virtues in this respect have been circulated, apparently by medical men, that a considerable number of persons are by this time probably convinced that a sea voyage is henceforth deprived of its greatest terror. We even confess to have had a certain amount of this misplaced faith ourselves. It is very gratifying, therefore, to be able to give the experiences of a number of unprejudiced experimenters upon the subject.

A discussion having arisen on the question at the French Academy of Medicine, some one proposed that as the members of the French Association for the Advancement of Science were about to cross the Mediterranean to the meeting at Oran, they should test the assertions made on of behalf antipyrine and other reputed remedies for sea-sickness on their voyage. The suggestion, either from a pure love of scientific experiment or perhaps from the union of that and some small desire to escape the well-known troubles of the voyager, was evidently taken up in a commendable spirit of self-sacrifice, which we regret to say failed to receive its fitting reward. For M. Baudouin, in the *Progrès Médical,* in giving the results of this trial, describes them as deplorable, and the failure as complete, even among those passengers who, not possessing sufficient courage to await the first attacks of sickness, had taken the antipyrine two or three days before embarking. On the steamer *La Ville de Rome,* for instance, out of 300 passengers, only four sat down at the table on leaving Marseilles, although sixty persons at least had taken from one to two grammes of antipyrine in the previous two hours. Moreover, M. Rollet, one of the passengers, asserts that several of his fellow-travellers accuse antipyrine of actually causing sickness, and M. Laborde affirms that the ingestion of this remedy (?) increases very greatly the afflictions so familiar to those who are subject to sea-sickness. The condemnation of antipyrine seems complete when it is added that some of the passengers from Marseilles to Oran, who suffered severely after taking it, returned without discomfort over a sea quite as rough as it had been on the outward passage.

THE POISON OF THE MOSQUITO.—Professor Macloskie (*American Naturalist*) shows that the mosquito, in addition to septic poisons which it may transfer from one person to another, elaborates a specific poison which it instils into the tissues at every bite.

ACTION OF HYDROGEN GAS ON THE ANIMAL ECONOMY.—Hydrogen gas, according to Dr. B. W. Richardson, if inhaled by warm-blooded animals, does not act as an anæsthetic, and quickly occasions death by asphyxia. Upon cold-blooded animals its action is slower, but ultimately fatal. Insects recover even after being confined in this gas for twelve hours.

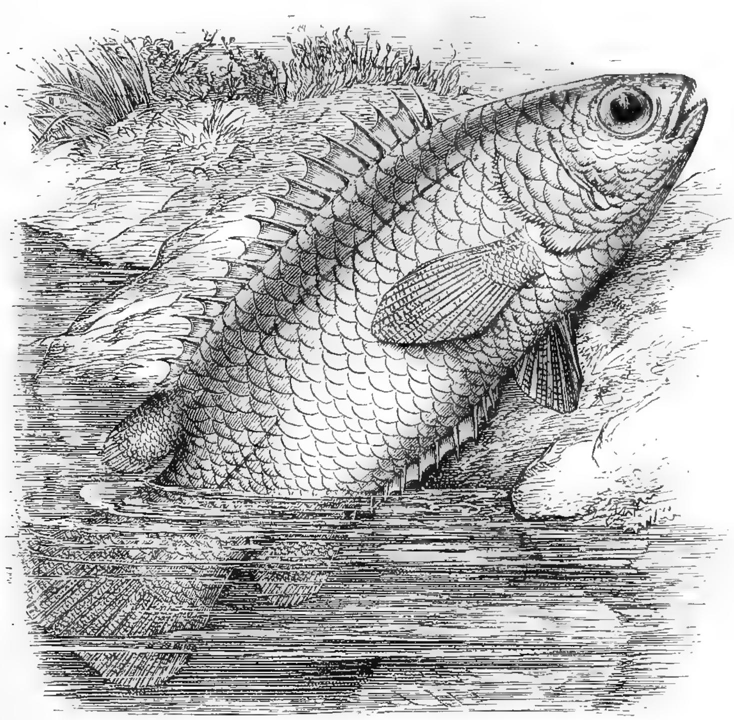
Natural History.

FISH OUT OF WATER.

THERE is remarkable variation in the period during which different fish continue to live when removed from their native element. Thus the herring, as is well known, dies almost immediately upon being lifted from the sea; whence, probably, the now proverbial phrase, "as dead as a herring." Many, as every angler knows, survive for several minutes after being brought into the air, while others, such as the carp, retain their vitality for half an hour, or in some cases even longer still. But there are yet others, again, which are able, not merely to exist for a time when removed from the water, but to leave it for hours or even days together of their own free will, in order that they may journey overland to other water at a considerable distance. And such peregrinations have even been known to take place beneath the fierce rays of an almost tropical sun.

The best known of these fishes is undoubtedly the famous Climbing Perch (*Anabas scandens*), a denizen of various Asiatic rivers, and a representative of a genus containing several species, all of which are gifted with similar powers. Inhabiting, as it so commonly does, the smaller streams, which practically cease to exist during the hotter months of the year, it frequently finds its native waters failing, and thereupon crawls ashore, works itself along by means of the alternate action of the lower fins, and starts off in search of more suitable quarters. Not uncommonly this singular fish is met with in great numbers, all journeying along together. Sir J. Emerson Tennent, for example, has published an account, supplied to him by an eye-witness, of the wanderings of quite a small host, which were passing over ground baked and cracked by the heat of the sun, and employing as much exertion in travelling fifty or sixty yards as would have carried them over half a mile at least of ordinary country.

It has been asserted by more than one writer that this fish possesses—and exercises—the power of ascending the trunks of palm-trees, in quest of any water that may have lodged at the junction of the dead leaves with the stems. But this statement appears to be wholly untrue. Of the migratory performances of the fish, however, there can be no possible doubt; and so well known is its capability of living out of water for a prolonged period, that the fishermen of the Ganges, who use it largely as food, carry it home in a dry earthen vessel, and there leave it alive, perhaps for five or six days, until required for use. And at the end of that time it is still healthy and vigorous. And many of the Indian jugglers carry a specimen or two about with them in much the same manner, as part of their stock of apparatus.



CLIMBING PERCH.

Another fish of somewhat similar habits is the Coramota, or Walking Fish (*Ophiocephalus gachua*), which is a native of Eastern India and the Indian Archipelago, and is again the representative of a somewhat numerous family. Like the climbing perch, it is quite a well-known traveller, and there is a widely-spread popular impression to the effect that it is brought down from the clouds in a storm of rain, just as has so often been reported of frogs in our own country. But the true explanation is a very simple one. As the summer advances and the smaller streams dry up, the water lies for a time in small pools here and there in their beds, and to these pools the fish resort in great numbers. As the heat increases, however, even these evaporate; and so the fish are left buried in the mud. There, however, they live quite uninjured until a few hours of tropical rain soften the baked earth and set them free. And then they proceed to wander over the neighbouring country, and appearing, as they do, immediately after the rain has ceased, give rise to the impression that they have actually been brought down by it from the clouds.

Although they can thus live interred, as it were, for a considerable time, it would seem that the presence of some slight degree of moisture is indispensable to their welfare, for it has been found that, if a cloth be laid over the mud beneath which they are lying, they shortly become stupefied and die. That, of course, is because the air-supply is cut off. But they cannot breathe air as we breathe it, for the simple reason that they possess, not lungs, but gills; and therefore oxygen, to benefit them at all, must be obtainable through the medium of water. Now the fish, seeming to be instinctively aware of this fact, is careful to bury itself at such a depth in the mud that the moisture cannot wholly disappear, no matter how thoroughly the surface may be baked and hardened. And by this moisture air is absorbed, and from it transferred to the gills. Even from a depth of more than two feet are these fish sometimes disinterred.

Eels again are great travellers, and will cross large meadows in search of more congenial quarters. But they prefer to do so by night, when the herbage is moist with dew, and seldom or never pass over a perfectly dry surface. And there are numbers of other fish which systematically leave the water in search of food, although not for periods so prolonged. Thus the Jumper Fish (*Salarias tridactylus*), resident in the seas of the Indian Archipelago, constantly springs out of the water, scrambles about over the stones and rocks lying upon the beach, and snaps up flies and various other small creatures in multitudes. And it can even climb up an almost perpendicular surface, adhering so tightly to its hold that the waves beat upon it in vain. The Shanny (*Blennius pholis*), when the tide is retreating, commonly takes up temporary quarters in some convenient crevice, and there remains for some four or five hours until the water returns. And Mr. Couch tells us that he has known a specimen to be perfectly vigorous and lively after no less than thirty hours' confinement in a dry box. And there is an extraordinary little fish known as *Anableps tetrophthalmus*, or Four Eyes (so termed by reason of the apparent division of each eye into two parts), which behaves very much like the Jumper, and seems quite indifferent as to whether it is in the water or not.

Now the power of all these fishes to remain out of water obviously depends entirely upon the structure of the gills. A fish breathes by taking in water through the mouth, and expelling it through the apertures situated upon either side of the neck, a portion of the oxygen being abstracted by the gills during its passage; not, of course, the oxygen entering into its actual composition, but that which is dissolved in it by absorption from the atmosphere. And when a fish is brought to land it dies, not because the air is actually injurious to it, but because the delicate gill-membranes become dry and collapse against one another, thus stopping the circulation. Therefore it follows that those fish whose gills retain their moisture the longest will best endure removal from the water. And in such species as those described above, a special structure is provided by which a certain amount of moisture is retained and stored up, and in such a manner that the gills can be moistened as often as required. In the Climbing Perch, for example, the pharyngeal bones which support the orifice between the mouth and the gullet are not only greatly enlarged, but are modified in such a manner as to form a most elaborate series of cells wherein water can be stored away very much as it is in the cells of a camel's stomach. And a little of this water passes to the gills whenever necessary. In the *Ophiocephali* a tolerably large cavity lies just above the gills with which it possesses direct communication; and within this cavity a considerable amount of water can be retained, and doled out from time to time in such small quantities as may be necessary. And there is a somewhat similar arrangement in the case of the eels. Thus in all these fish existence can be maintained upon land until the moisture in the reservoirs is exhausted; and that moisture, as fast as it passes to the gills, absorbs the oxygen from the air, to give it up immediately afterwards to the minute vessels with which the respiratory organs are closely studded. And so a structure is provided upon which the existence of the vast majority of individuals absolutely depends. Living under such conditions as those in which they are placed; liable, and indeed almost certain, during the months of summer, to be stranded by the subsidence of their native streams: nothing but the power of migration could save them from destruction. Therefore are they enabled for a time almost to set at nought the very laws of their being, and by a slight modification of structure to breathe through water even while living in air.

HERONS AND HERONRIES.—Mr. E. A. Fitch, F.E.S., communicates an interesting paper on this subject to the *Essex Naturalist*. The principal heronries still existing in Essex are those of Boreham, Birch, Wanstead, and St. Osyth. A heronry, however romantic it may seem, is an almost unbearable nuisance, both on account of the noise and the stench. Herons prey not only on fish, but on mice, rats, rabbits, snipe, young ducks, etc.

COLIAS EDUSA AT WOODFORD.—A male specimen of this species has been caught, according to the *Essex Naturalist*, at Woodford, in that county, as late as September 7th. In 1877 this butterfly, known as the "clouded yellow," occurred in thousands in Essex, as well as in the other eastern and southern counties. Since then, according to Mr. W. Cole, it has been very rare, though its food plants are abundant in every parish, and we have had seasons, to all appearance, as suitable as that of 1877.

A PARASITE DESTRUCTIVE TO SARDINES.—M. L. Joubin has read before the Paris Academy of Sciences an account of a parasitic crustacean, which occasions serious havoc among the sardines on the western coasts of France. The presence of this pest was first noticed by M. Moreau, in the spring of 1887. M. Joubin finds that it belongs to a genus nearly allied to the *Lerneonoma* or *Lerneascus*. It consists of a rounded head from two to three millimetres in diameter, armed with three large recurved horns, and antennæ of the shape of nippers. It has a long neck, a cylindrical thorax, and a short abdomen, followed by large ovaries. The head and a part of the neck are buried in the body of the fish, and the recurved horns prevent its extraction. The parts of the sardine which it chiefly attacks are the hinder end of the dorsal fin, the eye, the sides of the abdomen, and the root of the tail.

Nearly half the fish taken at La Nouvelle were thus infested. At Port Vendres and Banyuls not more than one in thirty or forty was attacked. At Rascoff there were none of the parasites found in July, but in October they were abundant. They occasion large abscesses, which kill the fish by exhaustion.

Swarm of Libellula Quadrimaculata.—According to the *Entomologist's Monthly Magazine*, a migratory swarm of this insect appeared off the Essex coast last summer. Mr. R. McLachlan, F.R.S., mentions that such swarms are not uncommon on the Continent, but are unexampled in this country.

The Fallow Deer.—There are two varieties of the Fallow Deer (*Cervus dura*) common in parks in this country, namely, the spotted and the black. Until recently it has always been supposed that the dark variety was introduced into England from Norway by James I. in 1602, on account of its superior hardness of constitution; but Mr. J. E. Harting now proves, in his excellent work entitled "Essays on Sport and Natural History," that a dark race of Fallow Deer existed in this country at least two centuries earlier than the date above given. This deer is a native of Southern Europe and North Africa, but the date of its introduction into this country is uncertain. It was probably never indigenous in any part of the British Isles in historic times.

The Rabbit Pest in Australia.—According to the *Queenslander*, Pasteur's remedy for this scourge is still doubtful. The rabbits which had eaten vegetables sprinkled with a culture of chicken-cholera died, but the disease did not spread to other rabbits in the same enclosure. Dr. Bancroft has studied the coccidium parasite, which lodges in the liver and is a common affection in rabbits, and he thinks that there would be neither difficulty nor danger in infecting rabbit colonies with this parasite.

Bird-work *v.* Child-work.—In England we often see rooks, starlings, and, in coast localities, gulls following the plough and picking up the grubs or maggots which the ploughshare turns up. In France, where such birds have mostly been shot down, we see the same task performed by children who have to follow the plough, each provided with a little jar for the reception of the *vers blancs*, the larvæ of the destructive cockchafer. It need scarcely be said that the work is done less perfectly and at greater cost than if it had been committed to the birds. Besides, the children ought to be at school, or at play.

Comparative Development of the Sense of Smell.—Recent experiments have shown that on the average the sense of smell is more acute in men than in women, and that they consequently can detect and recognise smaller quantities of odoriferous substances. If we compare the olfactory organs of male and female insects, we find that in a majority of cases those of the males are the more highly developed, so that a sexual difference in this sense may be traced very widely in the animal kingdom.

Fauna of Fernando de Noronha.—Mr. J. C. Braune discusses, in the *American Naturalist*, the peculiar fauna of these islands and the probable means of its introduction. The chief mammalian species present are rats and mice, which are numerous to a degree probably unequalled. There are no serpents, but there is found an *Amphisbæna*, which the Brazilians call the two-headed snake. There is also a lizard which has sometimes a forked tail. The tail of this species is long and brittle, and if a broken portion does not fall off, the fracture may heal over so as to hold it securely, whilst by its side a new tail sprouts from the injured part.

Respective Power of Vision in the Eyes.—In a number of persons whose keennesses of eyesight was tested in the Anthropometric Laboratory in Manchester, the right eye was found to have the advantage over the left.

The Pigment of Blood as a Means of Distinguishing the Interchange of Gases in Plants in the Light and in Darkness.—The production of free oxygen can be shown by means of hæmoglobine, which is converted into oxyhæmoglobine, and shows the two well-known absorption bands. If a straight thread of Spirogyra, placed in the colouring-matter of venous blood, is illuminated with a spectrum, there is formed a bright red zone of oxyhæmoglobine, which begins in the extreme red, rises as far as C, and declines from there to the green, where it disappears.

Survival of the American Bison.—It is interesting to learn that, according to Professor R. T. Hill, of the University of Texas, two herds of the American bison (commonly miscalled buffalo) still exist in Texas. The proprietors of the ranches are, according to our contemporary *Science*, doing much for their protection.

THE TEETH OF WHALES.

Part II.

Of those cetaceans which possess teeth in the strict sense of the word we have an admirable example in the cachalot, or spermaceti whale, a creature which feeds upon many of the larger fish, and no doubt finds its dental armature of considerable service in holding its active and slippery prey.

In this whale the teeth are principally situated in the lower jaw, and fit, when the mouth is closed, into conical cavities provided for them in the upper. They are large, strong, and massive, of fine quality as far as their actual substance is concerned, but not of any great hardness. So, at least, it would seem from the fact that in an adult whale they are always more or less blunted, while in an old animal the points are completely worn away. Their number is very variable. A spermaceti whale may have more than fifty teeth, or it may have less than forty, this variation being due to individual idiosyncrasy, and not to accidental loss. But the average number would seem to be forty-two, of which sixteen are situated in the upper jaw.

These latter, however, are very easily overlooked, for they project so little from the gum (scarcely more than half an inch) that only by a careful search are they likely to be detected at all. Nor do they seem of any great importance, for they are so slightly attached to the jaw-bone that, when the skull is being prepared, they almost invariably come away together with the gum in which they are imbedded.

By the natives of the South Sea Islands the teeth of this whale are, or were, held in the highest veneration, and considered as much too precious to be owned by any private individual. And more than once has one tribe actually gone to war with another in order to secure one ot these coveted trophies, that it might be dedicated to some idol deity, or take first place among the treasures of the regal dwelling.

In the black whales, two or three species ot which are recognised, the teeth are also very large and strong, averaging some nine inches in total length, of which as nearly as possible two-thirds are buried in the gum and the jaw-bone. The base of each tooth is hollowed to a distance of several inches, but its substance is, nevertheless, so dense and heavy that even a dried tooth will often weigh from sixteen to eighteen ounces.

A most remarkable modification of the dental armature we find in the narwhal, whose lower teeth are absolutely wanting, while those of the upper jaw are represented by two only. In the female animal even these two are not, as a rule, developed; without teeth she is born, and without teeth she lives and dies. But in the male, one at least, which probably represents the left upper canine, is invariably developed in a most astonishing degree, and assumes the form of a tapering, spiral rod of ivory some eight or nine feet in length; and not very uncommonly the other is developed with it. A very fine example of a two-tusked narwhal, for instance, may be seen in the museum at Hull.

But, as a general rule, one tusk only is present, the corresponding tooth remaining throughout life in a rudimentary condition. And what the function or functions of this tusk may be is still a matter of conjecture. Many theories, however, have been put forward upon the subject, most of them based upon the fact that the tip of the tusk is always smooth and polished, as though by incessant use, while the remainder is more or less encrusted, and is evidently not subjected to regular friction. Thus it has been urged that the animal employs its weapon for spearing fish, driving at them very much as a mediæval knight, his lance in rest, rode at a mounted foe. But this theory will not bear examination, and is open to two fatal objections. How, in the first place, supposing that the narwhal does so transfix its victims, is it to remove them from its spear and transfer them to its mouth? For it has no limbs available for such a purpose. Is it to be incessantly tantalised by the sight of food in close proximity to its jaw, which no efforts of its own will enable it to devour? And, moreover, if such be the duty of the tusk, why is it wanting in the female? For only in exceptional cases does she possess it.

Another theory, adopted by Fabricius, is to the effect that the tusk is employed in opening ice-holes in the huge floes which in winter cover the northern seas. But again, if this be so, why has Nature omitted to supply the organ in question to the female narwhal, whose need of air is as great as that of her mate? And how is the animal, supposing it to be capable of maintaining a perpendicular position in the water, to revolve while the boring operation is in progress? Such a feat, from its very structure, is absolutely impossible.

A third theorist suggests that the animal, when in want of food, descends to the depths of ocean, and stirs up the mud with its tusk in order to disturb any flat fish which may be lying upon it, recognising the fact that while at rest they assimilate so exactly to their surroundings that the keenest eye cannot detect them. But this theory, a somewhat fanciful one at best, is again negatived by the sexual difference already referred to.

Seeing that the tusk, broadly speaking, is a masculine appendage only, the probability is that it is employed as a weapon, not in the capture of prey, but in those combats which are frequent among male animals, more especially during the earlier part of the breeding season. We know that the male seals and walruses fight with great ferocity at that period, just as do many of the terrestrial mammals; and seals and walruses are at any rate allied to the cetaceans. And we have it, moreover, upon no less authority than that of Scoresby, the celebrated traveller and explorer, that quite large companies of male narwhals are sometimes to be seen gambolling together, crossing their long tusks, and fencing like experienced swordsmen. And it is more than likely that during the season of pairing such mimic warfare gives place to battle in grim earnest. Even if such be the case, however, it is still hard to account for the highly polished condition of the last few inches of the tusk, which part alone seems to be in constant use, and to be subjected to friction. Thus it may well be that the weapon in question has its supplementary uses, although we have as yet failed to discover them.

Although the female narwhal is not, as a rule, armed after the manner of her formidable mate, specimens ot the gentler sex are occasionally taken in which the tusk is present; and at least two cases have been recorded in which both canines, in the female animal, were similarly developed. In one of these cases the one tusk was seven feet and five inches long, and the other seven feet. Most probably females so armed are barren, their reproductive energies being diverted into other channels, and bringing about the assumption of characters ordinarily denied to them. And we have an analogous case in the crowing and spur-bearing hens which are occasionally met with, and from which eggs may be expected in vain.

Very few of the toothed cetaceans at all resemble one another in their dentition, and the number of the teeth is especially variable. Thus, in the narwhal, as we have seen, only one is usually developed. In the *Mesoplodons*, of which Sowerby's whale may be taken as a type, and also in the *Ziphii*, two rather large teeth are present, one upon either side of the lower jaw. In the pilot whale, however, there are ninety-six, evenly divided upon either side of the mouth. The porpoise possesses from eighty to one hundred and four, the dolphin from one hundred and sixty to two hundred, while the *pontoporia*, an inmate of certain South American rivers, bears off the palm with from two hundred and twelve to two hundred and twenty-two. In these last the teeth are sometimes very irregularly distributed. Thus, in the jaw of a Gangetic dolphin were found the singular number of one hundred and seventeen teeth, fifty-seven being situated upon one side of the mouth, and sixty upon the other. In apportioning teeth to the cetaceans, in fact, Nature almost seems to have laid rules aside altogether, and to have left both number and position of those organs pretty well to mere chance, alike in the species and in the individual.

Reviews.

Theoretical Mechanics. By J. Edward Taylor, M.A., London. London: Longmans, Green, and Co.

One of the few tangible advantages ot the present system of examination is, that they create a demand for manuals of elementary science. It is, however, characteristic of such text-books to find that, as in the example before us, they are "written specially to meet the requirements of" this examination, "it will be specially helpful for that," and "it will also be found sufficient for the requirements of" the other.

Several matters call for revision. We object to the ideas of absolute rest and motion in treating of the mechanics of ordinary Euclidian space. Clerk Maxwell tells us that "it is impossible for us to speak of a body being at rest or in motion except with reference, expressed or implied, to some other body." Nor is it scientific to say that "the horizontal direction is the surface that a *limited* quantity of water assumes when at rest" (the italics are the author's). As an instance of unstable equilibrium, an illustration of a cart is given, in which the centre of gravity is considerably outside the base. The cart is not in equilibrium at all. Some examples are suggestive of "blind mathematics," *e.g.*, a "cylindrical tower of the same diameter throughout is 100 feet high, and weighs five tons," etc. Of what material can the author have been thinking? If of brickwork, it would have a sectional area of about one square foot; if of cork, it would be only about 7½ square feet. One hundred and thirty tons would be near the mark for a brick chimney of this height.

Plenty of examples might be taken from ordinary engineering practice without imagining so unlikely an instance as "a rod of cast iron 100 feet long, and cross section 12 square inches, stretches 3 inches under a certain tension."

The author is not so original and interesting as Professor Perry, nor so amusing as Professor Oliver Lodge, in their admirable text-books on the same subject, but he provides numerous illustrations and examples, both worked out in full and collected at the end of the chapters.

Colour: an Elementary Treatise. By Chas. T. Whitmell, B.Sc., F.G.S., M.A. 8vo, 233 pp., 4s. Cardiff: W. Lewis, 22, Duke Street. 1888.

It would be useless to enlarge on the importance of "colour" as a subject deserving attention, since we have continual evidence of the benefits derived from it, either in the way of enjoyment obtained by seeing the beautiful variations of colour in Nature and in the artistic reproductions of them, or in the form of comfort in the agreeable effects produced by the colours introduced for the adornment of our homes, or when it is found in its many useful applications. Although some are satisfied with the mere sensations produced by colour, others, of a wisely more inquiring mind, want to know whence arise these sensations. What is colour? Why is it produced? and where does it come from? To these latter the present volnme will specially recommend itself. This treatise differs from previous treatises on the same subject in following a definite scheme of treatment. The subject-matter is divided roughly into scientific and artistic divisions. In the first of these we find the following points discussed in the order given: nature of colour, production of colour, constants of colour, mixture of colour, results of mixing colours, complementary colours, theory of colour, colour blindness, and systematic classification of colour. The second division includes description of some colours and pigments, colour combinations, small interval and gradation, colour harmonies, and finally painting and decorative art; whilst in an appendix colour photometry and some other points are treated. Many of the most valuable scientific contributions, such as the work of Lord Rayleigh (pp. 36, 60, 86, 90, 107, etc.), of Koenigs (p. 121 *et seq.*), etc., etc., are set before the reader more fully than in previous books on colour; whilst Captain Abney's and Major-General Festing's results (p. 235) appear for the first time in a book of this kind. Many descriptions of experiments are given fully, so as to allow of their being repeated by the reader. This is a great advantage, for, as the author says, "matters which may appear dry and difficult to understand in reading will be found to wear quite a new aspect when tested by experiment." In spite of the copious table of contents, we think an alphabetical index would be a useful addition.

Macaws, Cockatoos, Parakeets, and Parrots. By the late Sir T. D. Lander, Bart., F.R.S.E., and Captain Thomas Brown, F.L.S. With Chapters on Diseases and Cages, from Dr. Karl Russ. Illustrated with Forty Engravings by Joseph B. Kidd, Member of the Scottish Academy of Painting, Sculpture and Architecture. London: Dean and Son.

This little book opens with an account of the "physical characters of parrots," in which we find no little repetition, sometimes with variations. Thus we read in one paragraph that the birds only lay three or four eggs at a time, whilst on the succeeding page we are told that the number of eggs hatched at a time varies from three to six. The eggs are said, in one place, to be "equally obtuse at both ends." But then follows the information that the eggs are "of the shape of a pear, slightly flattened at the broad end." The anecdote that "Scaliger saw one that performed the dance of the Savoyards, at the same time that it repeated their song," occurs twice, on page 17 and again at page 31. Such blemishes should be eliminated in the very probable case of a second edition.

It seems to us that the authors form much too low an estimate of the intelligence of parrots. It is easy to say, as do many writers, that their speech is "mere imitation." So is that of a young child. We have observed instances of parrots connecting their remarks with appropriate facts or events, and never uttering them under any other circumstances. Thus our own parrot, on seeing water drawn from a tap, has called out, "Water, water! Polly wants!" and has drunk eagerly on some being offered her. This speech has never been taught her, and it is never uttered on any other occasion. If any one comes into the kitchen with a basket or a parcel, she generally says, "What oo got?" Now, the bird in question is by no means exceptionally clever, and has never undergone any formal instruction. We by no means contend that parrots analyse the sentences they utter, no more than do your children. But we submit that they very frequently understand some particular phrase as a whole, and use it accordingly. We must remember that the parrot has no hereditary aptitudes to fall back upon. What would be the result if a pair of clever parrots were matched and their young brought up in human society, in a suitable climate, and under kind treatment, is an unsolved but highly interesting question.

The practical portion of this work is much better than the theoretical part. We are glad to see it formally admitted, contrary to the notion of many bird-fanciers, that parrots do drink and require a supply of water. The remarks on the diet and general treatment of parrots are valuable, and will save much misery to the birds, and disappointment to their owners.

Abstracts of Papers, Lectures, etc.

GEOLOGICAL SOCIETY.

At the meeting on November 21st, Mr. W. T. Blanford, LL.D., F.R.S., President, in the chair, W. Whitaker, Esq., B.A., F.R.S., F.G.S., who exhibited a series of specimens from the deep boring at Streatham, made some remarks upon the results obtained, of which the following is an abstract :—

After passing through 10 feet of gravel, etc., 153 of London clay, 88⅓ of Lower London Tertiaries, 623 of chalk (the least thickness in any of the deep borings in and near London), 28½ of upper greensand, and 188½ of gault, at the depth of 1081½ feet, hard limestone, mostly with rather large oolitic grains, was met with. This, with alternations of a finer character, sandy and clayey, lasted for only 38⅓ feet, being much less than the thickness of the Jurassic beds, either at Richmond or at Meux's boring. The general character of the cores showed a likeness to the forest marble, and the occurrence of *Ostrea acuminata* agreed therewith.

At the depth of 1,120 feet the tools entered a set of beds of much the same character as those that had been found beneath Jurassic beds at Richmond, and beneath gault at Kentish Town and at Crossness. The softer and more clayey components were not brought up; the harder consist of fine-grained compact sandstones, greenish-grey, sometimes with purplish mottlings or bandings, and here and there wholly of a dull reddish tint. With these there occur hard, clayey, and somewhat sandy beds, which are not calcareous, whilst most of the sandstones are. Thin veins of calcite are sometimes to be seen, and at others small concretionary calcareous nodules; but no trace of a fossil has been found.

The bedding is shown, both by the bands of colour, and by the tendency of the stone to fracture, to vary generally from about 20° to 30°.

In the absence of evidence it is hard to say what these beds are, and the possibilities of their age seem to range from Trias to Devonian. It is to be hoped that this question may be solved, as on it depends that of the possibility of the presence of coal-measures in the district; and Messrs. Docwra, the contractors of the works, have with great liberality undertaken to continue the boring-operations at their own expense for at least another week.

Details of the section will be given in a forthcoming Geological Survey Memoir, in which, moreover, the subject of the old rocks under London will be treated somewhat fully.

The President inquired how much had been accomplished during the last week.

Professor Judd had not much to add to Mr. Whitaker's statement. He noticed a great similarity in character to the rocks of the Richmond boring; but at Streatham the mesozoic beds were thinner. If an appeal was made to the scientific world, it should be done at once; it would be difficult to ask for assistance if the present character of the work was maintained.

Mr. Whitaker said that, under favourable circumstances, 30 feet a week could be accomplished. He had not much hope of a change in the character of the rocks.

The following communications were read :—

"Notes on the Remains and Affinities of five Genera of Mesozoic Reptiles." By R. Lydekker, Esq., B.A., F.G.S. This paper was divided into five sections. In the first the author described the dorsal vertebra of a small Dinosaur from the Cambridge greensand, which he regarded as probably identical with the genus *Syngonosaurus*, Seeley. Reasons were then given for regarding this form as being a member of the Scelidosauridæ, stress being laid on the absence of a costal facet on the centrum.

The second section described on axis vertebra from the Wealden of the Isle of Wight, which is evidently Dinosaurian, and may possibly belong to *Megalosaurus*.

In the third section the femur of a small Iguanodont from the Oxford clay, in the possession of A. R. Leeds, Esq., was described.

The imperfect skeleton of a Sauropterygian from the Oxford Clay near Bedford, which formed the subject of a previous communication, was redescribed. This specimen was identified with *Plesiosaurus philarchus*, Seeley, which it was proposed to refer to a new genus under the name of *Peloneustus*.

The paper concluded with a notice of the affinities of the Crocodilian genus *Geosaurus*. This form was shown to be closely allied to *Metriorhynchus*, both being characterised by the absence of dermal scutes and the presence of bony plates in the sclerotic. It was also shown that some of the species of *Cricosaurus* belong to the former genus; while there appear to be no grounds by which *Dacosaurus* (*Plesiosuchus*) can be separated from the same level.

"Notes on the Radiolaria of the London Clay." By W. H. Shrubsole, Esq., F.G.S.

Microscopical examination of the London Clay of Sheppey and elsewhere has afforded proof of the existence of a Diatomaceous zone near the base of the formation. The formation of a well for the Queenborough Cement Company in 1885 was the means of furnishing a laminated clay with glittering patches of Diatoms from a depth of 225 feet. In this were also found fairly good pyritized specimens of Radiolaria, some of which were submitted to Prof. Ernst Häckel, who found a large number of fragments of Tertiary Radiolaria, but few well-preserved specimens appertaining to the families Sphæroidea, Discoidea, and Cyrtoidea, and apparently identical with those described from the Tertiary Tripoli beds of Grotte. No new species occurred among the recognised forms.

Sketches made by Mr. A. L. Hammond were also submitted to Prof. Häckel, who stated that these forms were not identical with any known species, recent or fossil.

The Author described the following new species :— *Cornutella Hammondi*, *Spongodiscus asper*, and *Monosphæra toliapica*.

The specimens were preserved in iron-pyrites.

Some tetractinellid sponge-spicules from the washings were recognised by Professor Sollas.

The President observed that the particular advantage of a paper like the present is that it shows the value of searching. He doubted the advisability of coining new names.

Dr. Hinde asked whether the Radiolaria were uniformly pyritised; also whether the sponge-spicules had undergone a similar change.

Prof. T. Rupert Jones commented on the rarity of fossil Radiolaria. Some few have been found in the chalk. Their pyritisation would tend to their ready destruction.

The Author, in reply, said that he was not anxious to apply new names. He was doubtful whether any silica remained in the sponge-spicules or the Radiolaria, although some has been detected in the Diatoms.

"Description of a New Species of *Clupea* (*C. vectensis*) from Oligocene Strata in the Isle of Wight." By E. T. Newton, Esq., F.G.S.

A number of small fishes found by Mr. G. W. Colenutt, of Ryde, during his investigations of the Oligocene strata of the Isle of Wight, in beds belonging to the "Osborne Series," were described as belonging to a new species of *Clupea*. The specimens vary in length from twenty to nearly sixty millim. In all of them the head in much broken; but the rest of the body is beautifully preserved, showing most distinctly the vertebral column, ribs, fins, tail, and ventral spines. The single dorsal fin has its front rays about midway between the tip of the snout and the base of the tail, the ventral fins being immediately under the front of the dorsal and about midway between the pectoral and anal fins. The anal fin commences about halfway between the ventral fins and the base of the tail, occupying about two-thirds of that distance, and the tail is deeply forked. The scales are thin and in most cases much broken; while the ventral region of the body is armed with a row of strong spines. The spinal column contains about forty vertebræ, of which fourteen or fifteen are caudal. The bones of the head are mostly broken, but those of which the outline can be traced agree with the corresponding parts of the sprat.

These fishes are referred to the genus *Clupea*; but although very closely allied to the common herring and sprat, the relative positions of the dorsal and ventral fins, as well as the number of vertebræ, prevent their being placed in any known species either recent or fossil, and they are therefore regarded as a new form, and named *Clupea vectensis*.

The President was not surprised at the discovery of a *Clupea* in freshwater beds.

Mr. Whitaker had suggested that the discoverer should send the specimens to Mr. Newton, and congratulated himself upon the result. It was another case of the advantage of having good local observers.

Mr. A. Smith Woodward thought he could distinguish a series of small dorsal scutes in some specimens, and inquired as to the Author's interpretation of the appearances. Most of the Eocene Clupeoids of the United States exhibited such scutes, and formed the genus *Diplomystus*, Cope. If the British fossil proved to be of the same type, the fact would be specially interesting, for, in the Old World, *Diplomystus* had hitherto been detected only at Mt. Lebanon.

The Author thanked the speakers for their remarks. Whether or not any dorsal scutes occurred was uncertain; in some there seemed to be roughening. He thought it better to leave the specimens in the genus *Clupea*.

THE INSTITUTION OF CIVIL ENGINEERS.

At the meeting on the 4th of December, the President, Sir George B. Bruce, being in the chair, the paper read was on "The Influence of Chemical Composition on the Strength of Bessemer Steel Tires," by Mr. J. Oliver Arnold, F.C.S.

The author observed that there was a growing tendency amongst engineers to specify for tires steel possessing a high resistance to tension. This was conducive to economy in wear; but it was doubtful whether such material was not more liable to sudden fracture than a more ductile, if less durable, steel. The chemical composition necessary to obtain high-tensile strain, together with high elongation, was such as to render steel liable to molecular changes, which doubtless produced disastrous results. The author submitted the data upon which he based this conclusion. The question was rendered intricate by the fact that steel was a complex body, and that the influences of its elements upon each other, with reference to physical effect, had hitherto defied all attempts to reduce them to formulas; also by the difficulty of insuring in pieces of steel, identical in composition, a uniform and constant molecular structure.

In conclusion, the author said: It was worthy of remark that the elongation obtained on a 2-inch test-piece, marked at eight equal intervals, in order to ascertain the distribution of the elongation, showed that this was less in those parts distant from lines of fracture. The engineer held that a certain resistance to rupture under a falling weight, together with certain results obtained on the tensile testing machine, formed a criterion of the capacity of tires to meet strains when at work. This, though true in the majority of cases, had never been exhaustively proved. When the fracture of an axle or a tire led to some fatal disaster, the engineer was to some extent called before the bar of public opinion to account for the accident. In such cases, his explanation, that the breakage was due to an "original but invisible flaw," had become proverbial. An analysis and a tensile-test of the broken article had been made, and the results obtained had thrown no light on the matter. But the important question with regard to the mechanical test arose—Was the test-piece planed from the immediate vicinity of the fracture? The author had obtained data which proved that injurious molecular change might be very local. Returning to the question as to how far the tests to which tires were subjected before leaving the makers' works indicated their fitness to meet strains and vibrations, he suggested an investigation upon the following lines: At the works let tires be selected from groups, made from the same blows, each group being marked with a distinctive stamp. Let representative tires from each group be subjected to exhaustive chemical and mechanical tests. Let the exact mechanical treatment from ingot to finished wheel be faithfully recorded. When the life of one of these tires was finished, either from breakage or in the natural course, let the chemical and the mechanical tests be repeated. Such a series of tests would indicate whether the influences, encountered by a tire, were such as to bring about molecular change. They would also show the chemical composition, and the mechanical treatment, most conducive to injurious molecular rearrangement, and those most likely to retain a permanently tough molecular structure. Finally, the author referred to the hardening of steel generally, and the effects of molecular changes of steel.

SOCIETY OF ENGINEERS.

At a meeting on 3rd December, 1888, Mr. A. T. Walmisley, President, in the chair, a paper was read on "High Pressure Steam and Steam Engine Efficiency," by Mr. W. Worby Beaumont, M.Inst.C.E.

In the first part of the paper attention was again called to the misleading results of the common application of the theory of the perfect engine as a basis for an index to the comparative efficiency of actual engines, working under different conditions and with different pressures. Examples of the reasoning based upon this interpretation of the "Carnot" theorem, or this application of the "Carnot" ratio, were given as showing that it had been common to suppose that the useful limit to steam pressure would be reached at about 200 lbs. or below it. Reasons for expecting very large increase in available work as due to the increase of pressures up to at least 300 lbs. were given with figures showing the extra work available per extra unit of heat used.

In dealing with the steam engine as a heat engine, it was argued that considerations relative to the boiler as the producer of the steam and as the receiver of the hot water rejected by the engine are irrelevant; and, further, that no part of the history of the steam used should be included other than that part which begins with the admission of the steam into the cylinder and ends with its emission therefrom.

In estimating the quantity of steam required to perform a given quantity of work, the steam necessary to fill the cylinder at the pressure shown by indicator diagrams was not credited with providing any of the heat necessary for the performance of the work, excepting only the units of heat represented by the difference between the total heat of the steam at the initial and at the terminal pressures. In a non-expansive engine the whole of the heat equivalent of the work done would have, according to the paper, to be supplied in addition to that represented by the volume of steam required to fill the cylinder.

This heat was assumed to be supplied by initial condensation, and an object of the paper was to show that the performance of work alone demands sufficient heat to account (with the exception of some very small losses) for the whole of the observed initial cylinder condensation.

Proceeding on this thesis it was argued that cylinder condensation apart from this is a very small quantity in the best actual engines, and that it consists mainly in loss of heat by evaporation during exhaust, and of slight losses due to radiation and conduction, and to clearance space not filled at initial pressure by compression.

From this it was concluded—

1. That as small a portion of the cylinder capacity as possible should be subject to exhaust influences.

2. That it follows from 1 that multiple stage expansion is necessary with the high pressures that are advisable, and that high speeds of rotation ought to be attended with economy.

BELFAST NATURAL HISTORY AND PHILOSOPHICAL SOCIETY.

At a meeting held on Tuesday, Dec 4th, a lecture entitled "Soap Bubbles" was delivered by Mr. John Brown.

Professor Letts (the President) occupied the chair. The lecturer said—The record of men of science who have devoted attention to the phenomena connected with soap bubbles is a pretty large one, and includes such men as the celebrated Robert Boyle (who, in 1663, examined and tried to account for the colours of the bubble), Sir Isaac Newton, Hooke, Young, Leidenfrost, Brewster, Draper, Sir Wm. Thomson, and many others, as well as the great French physicist, Plateau, whose researches have a sadly pathetic interest, since he was in the midst of them attacked by a disease which deprived him of sight, and it was only with "that inner eye which no calamity could darken" that he continued to investigate these beautiful phenomena as their colours and forms were described to him by his two faithful friends and assistants, Duprez and Donny. The soap bubble is of interest, first, on account of the peculiarities of its own structure, its forms, its durability, and its colour; and, secondly, as an experimental tool for the investigation of other physical phenomena. The round form of a free bubble is due to the interaction of the air pressure inside it and the surface tension or elasticity of the liquid film. Both being equal all over the surface, it can be shown how no other figure could satisfy the conditions. The elasticity of the film is illustrated by hanging a bubble to a fixed wire ring and hanging to the bubble a second ring with a small weight attached. On allowing the air to escape by breaking the film inside the fixed ring the shrinking up of the film lifts the weight up to the upper ring. The colours of the bubble were for a long time a great puzzle to the early investigators, but since the discovery of the undulatory theory of light a satisfactory explanation of them has been found. They belong to a class of phenomena known as "colours of thin plates," and are caused by the "interference" of the light waves, reflected from the outer surface of the film with those reflected from the inner surface through the thickness of the film. The effect is to destroy some one colour in the light, leaving its complementary colour unbalanced, and therefore visibly tinting the otherwise white light. The matter is very clearly explained in Tyndall's charming book, "Lectures on Light." The colours are very well seen on a flat soap film attached to a ring of wire, or in a bubble partly filled by smoke, as was observed by Leidenfrost in the last century He compares the resulting effect to a brilliant star, and then he moralises quaintly, "But all this glory vanishes the moment the bubble bursts; the fetid smoke which escapes shows with what filth it was filled, and so offers us a striking picture of the gilded miseries of humanity." The well-known fact that two bubbles may be pressed together without coalescing is well illustrated by blowing one bubble inside another one hanging on a wire ring. The outer one must have either a drop of liquid or a wire ring hung to its under part, so as the thick under part of the inner one does not touch it; otherwise they will coalesce: or if the inner one be filled with coal gas it rises to the top of the outer one, which answers the same purpose. When the ring on which the outer one is fixed is very light and small the whole combination rises in the air, the inner bubble representing the bag of gas, the outer one the net, and the ring the car of the miniature balloon. As an experimental tool the bubble may be used to illustrate the diffusion of gases, a phenomenon examined and investigated by Graham, who, like other great pioneers of science, attacked the most abstruse problems with the simplest possible apparatus. It has been stated that his entire laboratory for his diffuson experiments was contained on an old tea tray, and consisted of a few glass tubes, phials, and tobacco-pipe stems, and some plaster of Paris. After all, as in the case of the astronomical telescope, it is the man at the small end that is of most importance. If an air bubble be placed in ether vapour for a few seconds, the vapour diffuses into the bubble in sufficient quantity to cause it to explode with a considerable burst of flame when taken out and applied to a light. The magnetic qualities of gases are conveniently studied when these are enclosed in bubbles. Although outside the domain of bubbles proper, one or two illustrations may be given of the beautiful geometrical forms produced by Plateau on wire frames after immersion in soap solution. A cubical frame shows an arrangement of one rectangular film in the middle joined to the corners by twelve trapezoidal films. A triangular prism gives a set of nine plane films, and a helix of wire gives a very pretty screw-shaped film. A frame consisting of three rings fixed to a centre forms a circular trough of soap films, round which bubbles may be rolled as the ball on a roulette table. The greater part of these experiments have been devised by Mr. C. V. Boys, F.R.S., of South Kensington Science Schools, and are described in a recent number of the *Philosophical Magazine*, where also he gives the ingredients of the solution used in forming the bubbles. Some are from other authors, and others have been devised specially for this evening. In conclusion, it may be asked *cui bono*—what is the good of it all? The seeker after knowledge asks no further result or reward than the pleasure of attaining definite knowledge. As the artist loves beauty, and will create beautiful forms for the mere love of his art, so the philosopher finds his keen pleasure in acquiring and setting in order new forms of knowledge. There is a keen delight in a new successful original experiment that belongs to few other enjoyments—in seeing for the first time that Nature has at length truly answered the question so often put in so many varied and doubtless imperfect forms before; a delight enhanced by the feeling that, having asked aright, we have been answered truly, for—

Nature never did betray
The heart that loved her.

ROYAL ACADEMY OF SCIENCES, AMSTERDAM.

At the meeting of the section of Physical Sciences on Saturday, 24th November, 1888, M. Hugo de Vries read a paper "On the Pangenesis of Darwin," urging that Darwin's doctrine presents a great many more data for the explanation of various phenomena on the domain of heredity than the doctrine of Weisman. The author especially demonstrated that the hypothesis of the transport of gemmules may be rejected without endangering the validity of the arguments in that hypothesis, which would connect the separate properties of any organism with some definite species of particles of living matter. He also pointed out that the theory expounded subsequently to Darwin, according to which the nucleus of the germ-cell must be the seat of heredity, is in accordance with the import of the last-mentioned hypothesis.

M. Martin demonstrated that the lower jaw found in the year 1823 when digging the canal called Zuid Willemsvaart, in the Kaberg, near Maestricht, and hitherto regarded as the remains of a so-called fossil or diluvial human being, was not found in the geological formation which harbours such remains, but in another of more recent date, so that the importance of this jaw—traced back by the author after a long and painful search in the anatomical cabinet of the Leyden University—can no longer be maintained.

M. Martin further stated that he discovered recently in a parcel of fossils collected by the mining engineer, J. A. Hooze, in Martapoera, some characteristic fossils from the chalk formation, and especially rudists; so that it is positively ascertained that in the South-Eastern parts of Borneo there exists a chalk formation, as was formerly supposed by Geinitz.

Victoria Institute.—At a meeting held on December 3rd, a lecture was delivered by the Rev. H. G. Tomkins on Biblical Ethnology, illustrated by means of a lantern with transparent photographs, which had been taken from the monuments themselves, and many of them from those discovered not more than a year ago at Bubastis and elsewhere. The photographs brought out the ethnographic distinctions between Egyptians, Assyrians, Israelites, Syrians, &c., with great clearness. The accuracy of the Egyptian sculptors may be attested by the fact that, although there are more figures of Rameses II. than of any other monarch, yet there is never any difficulty in deciding as to whom they are intended to represent. It is startling also to see on those ancient monuments, drawings and sculptures of Hebrew faces, of which we may find exact counterparts in the streets of London to-day.

Cambridge Antiquarian Society.—At the meeting on Monday, the 19th of November, Professor A. Macalister, M.D., F.R.S. (President) in the chair, the President exhibited and described a fragment of an Egyptian *Stele* belonging to Mr. Dodgson, of Ashton-under-Lyne. Professor J. H. Middleton made some remarks upon an altar-cloth from Lyng church, near Norwich, lent by the Rector, the Rev. C. Jex-Blake. Mr. Gadow made a few remarks upon an early Christian inscription found at Mertola, in Portugal, which had been kindly presented to the Society by Mr. T. M. Warden, an official of the Minade Sao Domingos, South Portugal.

Sheffield Microscopical Society.—The first of a series of "students' nights" in connection with this society was commenced on November 23rd, when Mr. W. Jenkinson explained the construction of the microscope, giving a full description and the uses of the various parts. Mr. G. A. Grierson gave a practical demonstration in botanical section cutting and mounting.

Edinburgh Association of Science and Arts.—The meeting was held on November 19th, Mr. J. M. Turnbull, President, in the chair. A paper on "The Principles of Ventilation" was read by Mr. A. D. Mackenzie. The lecturer first referred to the ventilation of buildings as not receiving the importance it deserved; it was too often an after-thought, considered only when the building was nearing completion, and therefore almost impossible to be effectually carried out. Dealing next with the proportions of the different gases necessary to support life, the lecturer said ventilation consisted largely of a process of dilution, a mixing more or less of the good air with the bad, and the reason of such a large supply of air being required was that they could not get the foul air away without more or less pollution of the new air. About 3,000 feet per hour of fresh air was estimated to be required for each individual, and that quantity was so large that it was almost impossible to provide for it in churches and halls. He was of opinion, however, that that quantity was far more than was necessary with any reasonably effective ventilation. He then stated the principles to be followed to ensure the proper ventilation of a room, and referred to the plan adopted in schools and other buildings of introducing fresh air all round the room, about six or eight feet up, and letting the foul air out at an opening near the floor, as an entirely erroneous principle, and one which ought to be condemned. It seemed to him that to secure a perfect system of ventilation the fresh air should be introduced as near the floor as possible, through as short a channel as possible, and should strike against some obstacle so as to break up the current. The obstacle should be a heating agent of some kind, as in our climate it was absolutely impossible to have effective ventilation at all seasons without means of heating the incoming air. The object of his paper was not to discuss the relative merits of the various systems, but if the principles were understood the details might be varied in any way to suit local peculiarities.

FLINTS.*

PROFESSOR JUDD said that in the previous lectures they had studied the facts which were taught them concerning flints— first by means of experiments, and they had seen that by such experiments they learned first the chemical constitution of flint, and secondly the physical properties presented by the substance; and in the second place they had tried to learn what was taught them concerning flints by observation, especially as to the mode of occurrence of this substance. That night he proposed that they should consider what the microscope taught them concerning flints. He must point out at the outset that the microscope was not, as many persons imagined, simply a toy to be played with, and that everybody who bought a microscope was of necessity a microscopist. Nobody going to a shop and buying a violin fancies he thereby becomes a violinist, even though the violin happens to be a Stradavarius, or other exceptionally good instrument. But somehow it had come to be thought that all that it is necessary for a man to be a microscopist is to buy a microscope, and if he buys a very expensive and a good one he is necessarily a very good microscopist. Such, however, was not the case. The results obtained by the aid of the microscope depend to a certain extent on the instrument, more could be done with a good instrument than with a bad one; but much more depended upon the eye that was placed behind the instrument, and still more on what happened to lie behind the eye. A good microscopist would do a great deal more with a bad microscope than a man who had not studied the use of the instrument at all would with the best instrument that was ever fashioned. That night he would only just call their attention to the nature of the instrument he was going to endeavour to employ that evening. The microscope he was now speaking of—the compound microscope, which was the form of instrument with which most of the important researches were made—consisted of a number of pieces of apparatus joined together, but he would only call attention to the essential parts. First, there were some lenses called the objective, or the object-glass, and upon the nature of those lenses the degree of magnification depended. There were objectives which would magnify only ten, or fifteen, or twenty times with the ordinary eye-piece, and others which would magnify many thousands of times. At the other end of the instrument they had another arrangement of lenses, constituting the eye-piece of the instrument. Now, attached to that particular instrument they had two other portions, which constituted the apparatus he had already spoken of as the polariscope. He had called their attention to the fact that they had two boxes, one below, and the other above the instrument, containing two transparent prisms of Iceland spar which polarised the light; and he had shown them that although there was nothing but a transparent body between the eye and the light of the microscope, yet when those prisms were turned in a particular position no light passed through unless a crystallised substance was placed upon the stage of the microscope, in which case they got coloured light, which varied with the nature of the crystallised substance used. Now, having called those facts to their remembrance, he would point out that they had a microscope arranged in a somewhat different form from the microscope which was upon the table, which could only be used by one person at a time. If he wished to study flints for himself he should not ask for a better instrument than that on the table, but unfortunately he could only use it himself or ask others to come round one at a time to use it. In order to get over that difficulty he would endeavour to throw pictures of what was seen under a microscope on to a screen. The way to throw those pictures on a screen was to get an exceedingly powerful light, and to pass that light through the objective, and by means of lenses in front of the eye-piece, to form images on the screen. The great difficulty, however, was that this objective, especially if it magnified greatly, was of very small diameter, and the light used must go through a very minute aperture, and it was afterwards spread out by the lens on to a large surface. Now, in order to get sufficient light to show objects in a room of that size it was necessary to have a most powerful light, and for that purpose he used the form of electric light, which gave them very good results. It was worked, like the electric lights used for illuminating the adjoining museum, from a dynamo. Everything depended upon the light being sufficiently bright to retain a sufficient light when spread over a very considerable area. He had hoped he should be able to show them some things with tolerably high powers; but unfortunately the instrument had gone back to the maker, and he had retained it until the last moment, and even now he had sent it back without making those alterations which were specially demanded. He would, however, he hoped, be able to show them a sufficient number of objects with a moderate power, a power of magnifying something like thirty-five times or forty times; that was, every object would be magnified, as seen in the first instance, thirty or forty times their length and breadth. He hoped they would be able to see most of the points that he had called their attention to. Now, the question might arise, how should they examine flint with the microscope? If he put flint under the microscope they would see very little of it. Flint, however, was a translucent object, and if they took a hammer and struck it they might get off flakes so thin that light would pass through them. Moreover he had pointed out to them that flints, like some other forms of silica, could absorb liquids, and if it was placed in oil they

* Fourth Lecture to Working Men at the Royal School of Mines.

could make the flint very much more transparent than it would otherwise be. But for most purposes it was desirable to make a thin slice or section of the flint, and this was done by a very simple contrivance. If we take a piece of glass, and having broken off a convenient piece of flint, one side was ground down flat and smooth on some powder, like emery or other grinding material. Having done that, the smooth side of the piece of flint was stuck on a piece of glass and then turned over, and the other side of the flint ground until nearly all of it was ground away, and there was nothing left but a thin film of the rock, of which they wished to take the section. In practice, by using a lapidary's wheel they might shorten the task. He would now see if it was possible to show some facts about the microscopic structure of flint which would aid them in reasoning concerning the nature of the origin of flint. He would first endeavour to show some sections of chalk, a substance in which, as they learned in the last lecture, flint was always found. [Sections of chalk exhibited.] Sometimes, when the sections did not give them the information they desired, they might see what was the nature of the chalk by washing it with a stiff brush, when they could separate the number of minute shells of which it was made up, and study them individually. On the screen were shown a number of straight, wedge-shaped fragments, and there were a number of rounded bodies which had the forms of shells. He would endeavour to show them what was the nature of the globigerina-ooze which resembled chalk. Most of them could see it had those peculiar forms of shells that he exhibited to them the other day. There were a number of globular bodies united together, making up these shells. The darkness of those objects was due to the fact that the specimen exhibited was fresh ooze from the bottom of the Atlantic, and the dried-up bodies of the animals were in the shells. [Lantern slide : showing shells of great variety of forms.] When the sections of the chalk were carefully examined by the aid of the microscope, all the objects were found which were found in the mud at the bottom of the Atlantic. [Picture of objects taken from surface of water during *Challenger* Expedition.] Many of them were soft-bodied creatures which left no trace behind them, but the shells dropped to the bottom of the ocean, and formed the mud of which he had spoken. Now he must call their attention to the fact that there was one considerable difference between globigerina ooze and chalk. Hitherto he had dwelt on the close resemblance there was between globigerina ooze and chalk. Globigerina ooze differed from the chalk, however, in the fact that when they dissolved the chalk in an acid, such as vinegar, they got very little residue, and that residue seldom presented any definite forms. Here and there was found a trace of some wonderful structure composed of the substance silica, which was not dissolved by ordinary acids, but generally there were no traces of such organisms; but if they dissolved most kinds of globigerina ooze in acid, there was left behind a considerable number of skeleton organisms composed of the unsoluble substance silica, and these siliceous organisms composed of silica belonged to three sorts of organisms : first the plant known as diatoms or diatomaceæ; secondly, animals called radiolarians ; and thirdly, the spicules found in the sponges. Those sponges, like Venus's flower-basket, had skeletons made up of silica. In the diagram they had last week they had before them some wonderful varieties of structures which existed among those three forms of life—diatoms, which were plants; radiolarians and siliceous sponges, which were animals. [Specimens shown by lantern of siliceous organisms which exist in the ooze at the bottom of the Atlantic Ocean, but which were not found in chalk.] This was a very beautiful object, and that which looked like vegetable was an accumulated series of organisms which he had spoken of as diatomacæ and they required a very powerful microscope to under stand them. [Further lantern slides of a white powdery material, formerly largely dug for making dynamite, because it absorbed the nitroglycerine better than any other substance which had been tried were then exhibited. [Specimens were shown of material dredged by *Challenger* from the bottom of the Antarctic and South Pacific Oceans. Also specimens of radiolarians; and the lecturer spoke of the wonderful diversity of form and size they represented.] This was material dredged from the bottom of the Atlantic, but in many cases rocks were found made up entirely of these organisms. A work on the subject of these radiolarians had been published by Prof. Haeckel, of Jena, in which he described 4,000 forms, and said that he had far from exhausted all those brought home by the *Challenger* Expedition. [Numerous specimens of radiolarians and transparent rods, which were spicules of sponges, wonderful forms presented by siliceous organisms which went to build up the spicules of sponges; some formed meshes consisting of six branches. These objects were all composed of silica.] The next thing which he had to call their attention to was that the silica comprising these organisms was all in the condition of colloidal silica, and there was a test, as he had pointed out, by means of which they could distinguish colloidal silica from crystalline silica. Colloidal silica, as they had seen, was remarkable for the ease with which it passed into a state of solution, and he should be able to show them that in many cases these beautiful siliceous organisms, which were composed of colloidal silica, were easily dissolved. First he should endeavour to show by polarised light that those objects were composed of colloidal silica; and secondly he should endeavour to show that in many cases those objects had been dissolved, and were sometimes redeposited; and that this colloidal silica passed over into the crystalline condition. In the first place he would endeavour to show them the fact that these objects were really composed of colloidal silica, and not of crystalline silica. That was shown by the fact that colloidal silica did not affect polarised light. Therefore, if they attached the polariscope to the microscope, and put the prisms in such a position that it stopped off all light, these masses of colloidal silica remained dark, whereas if they consisted of crystalline silica they would get a coloured light. [Specimens of sponge spicule; dissolved globigerina ooze, the residue of which, however, did not contain any of the beautiful forms of radiolarians or diatoms or sponge spicules.] He wanted them to remember the fact that silica was, in the rocks they had studied, in a state of solution, and that it was frequently deposited from a state of solution, sometimes in a colloidal condition, and sometimes in a crystalline condition. The other limestones of the globe, if dissolved in acid, left behind a minute residue, and that residue, if examined in the way they examined it now, was seen to be composed of a great number of beautiful little crystals cf quartz. They saw nothing of the radiolarians etc. because the silica had passed into a state of solution, and been separated and deposited in the form of crystalline quartz. [Another example of the way in which silica was deposited in rocks, owing to its being continually in a state of solution, was shown by the lantern.] There were a number of sand grains which were remarkably opaque, because they were covered with iron rust or iron oxide; but if they were put into acid the iron rust was dissolved, and they got a crystalline form. The sand grains were little fragments of quartz crystals, and when silica in a state of solution came into contact with them the broken crystals were reformed, and thus they had that wonderful deposition of silica upon the outside of the sand grain. Now he must call their attention to certain very interesting facts which resulted from this circumstance of silica so constantly being present in a state of solution. As silica was almost everywhere passing through the rocks in a state of solution, it might constantly be deposited in the rocks, and it had a wonderful power of replacing other substances. Very frequently the remains of plants and animals might be entirely dissolved away, and as portions of the plant or animal structure were carried away in solution, particles of silica were deposited, which took the place originally filled by carbonate of lime or other substance, which formed part of the animal or vegetable structure. That was a form of fossilisation. When the materials of the organism were removed and the mineral substance deposited in its place, it was said to be fossilised, and this particular form was called silicification. Now the wonderful thing was the way in which this silicification went on. For example, in trunks of trees and vegetable objects every portion of carbon, oxygen, and hydrogen which composed the plant tissues might be removed particle by particle, and particles of silica put in their place, and this work might be done so perfectly that the structure retained its original form and all its delicate features. They could imagine it possible that a building like that (the Museum of Practical Geology), which happened to be built of stone, might have every stone taken out and bricks put into their places, and so the stone building would be converted into a brick building. Or they might have the limestone removed stone by stone, and sandstone put in its place. That was what was done in silicification, only the bricks were so minute, and so perfectly did Nature do her work, that when they took a section and examined it with the microscope, they found all the minutest structures reproduced in the silica. [Specimen shown with lantern, of piece of wood which had been completely silicified.] All the delicate cells and vessels were completely reproduced; and all the foreign substances which lay in those cells were reproduced in the silica, and if they were to analyse those flints they would find only a minute percentage of the original elements—the carbon, the hydrogen, the oxygen, and the nitrogen. This work of silicification had gone on in such a way that as each molecule of the plant-tissue had been removed a molecule of silica had taken its place, and its whole structure had been reproduced, and all its minutest details were produced with the greatest accuracy. Not only were plants silicified, but so were corals and many other structures. [Specimens of fossils building up some of the varieties of chalk were shown.] Those fossils originally consisted of calcic carbonate, or carbonate of lime. Sometimes a whole mass of chalk was converted into silica. [Specimen of mass of chalk from Scotland, which was full of organisms exactly like those of ordinary chalk, and the whole mass had been converted into flint. It was a mass of chalk, in which the process of silicification had gone on to the fullest extent.] Sometimes those objects had undergone a remarkable and considerable change. The colloidal silica, of which they were originally formed, had been converted into crystalline silica. Now he had to call their attention to the fact that when they studied a large series of flints they would find that some of those flints were most obviously nothing but chalk-mud, which had been silicified. All the characters that were seen in chalk-mud were found in these particular flints. But as they studied flints they would find a wonderful change went on in them. They would find that the colloidal silica forming the flints had been converted into crystalline silica; they would find that the colloidal silica which had filled up all the interspaces between the organisms had in some cases undergone a similar change, and that the material had assumed a more or less perfectly crystalline character. Thus in some flint they might recognise chalk mud in which perfect silicification had taken place; every particle of chalk mud had been removed in a state of solution, and colloidal silica had been put in its place. From that first stage they would trace a perfect series of gradations. They would find minute crystals taking the place of original colloidal silica, and this crystalline character might go on increasing and increasing until at last the whole of the original organic structures were completely obliterated, and there was nothing but a crystalline appearance. He would point out that flints presented too many different appearances. Sometimes flints appeared black, or, at all events, a dark colour. At other times they appeared perfectly white. As he pointed out in his last lecture, they sometimes found white flint in the interior of black flint, and a layer of white flint on the outside. Generally they found white flint in the interior, with black outside.

If they took a piece of black and a piece of white flint, and examined them carefully by means of chemical analysis, it would be found that they did not differ in their composition. Black and white flint consisted of silica and nothing but silica; but the difference between these two substances was entirely a difference of aggregation. A piece of blotting paper was opaque, but put oil on it and it became transparent. It was the same with black or white flint. When flints were examined microscopically they would find in the white flint a great number of particles of silica separated by air, but in the translucent black flint colloidal silica had been deposited in the interspaces, and they got a continuous light. The oil on the blotting paper had nearly the same effect upon light as the silica has in the interspaces of flint—they got a continuous stratum through which the light passed freely. [Pictures on screen by aid of lantern showing differences which are presented in flints.] He had introduced the last two slides in order to bring before them clearly the distinction of the two forms of silica, and the fact that one kind of silica was constantly found passing into the other kind. They had most of them that evening seen on the screen with the actual eye or with the eye of faith, a sufficient number of these objects to enable them to reason upon them as he hoped to do in their next lecture, in which he would endeavour to show how these facts that they had been collecting in the four lectures already given would enable them to frame a reasonable theory concerning the *origin* of flints.

RECENT INVENTIONS.

The following list has been compiled especially for the SCIENTIFIC NEWS *by Messrs.* W. P. THOMPSON *and* BOULT, *Patent Agents, of* 234, *High Holborn, London, W.C.; Newcastle Chambers, Angel Row, Nottingham; Ducie Buildings, Bank Street, Manchester; and* 6, *Lord Street, Liverpool.*

BATTERIES.—Mr. H. Thaine has patented a secondary battery. This invention dispenses with the use of perishable materials as far as practicable, and employs uncured or unvulcanised indiarubber, either in sheets or small pieces. The rubber is subjected to a gentle heat to soften it, and whilst soft lead in narrow strips or dust is mixed with it to render it porous. Plates thus formed contain a greater proportion of active material, and are practically unbreakable, and may be made into any suitable shape.

ELECTRICAL APPARATUS.—Mr. A. M. Taylor has patented an electrical transforming apparatus. It relates to means for compensating for the effects produced in a system where a constant electrical current is maintained in a primary circuit, and in which various inductors are arranged in series. It consists in combining with each of a number of inductors an independent core of iron, wound with a coil of low resistance in shunt from the primary inductor coil, with or without separate convolutions connected to the secondary.

AERIAL PROPULSION.—Mr. G. S. Parkinson has patented means for aërial propulsion. Any ordinary balloon is employed having a depending car to which is fixed an air-fan, or blower. To the axis of the fan is affixed a tube, which is passed into the body of the balloon from the base, and is divided into three channels, which terminate one at the end and on each side of balloon, opening into the air with trumpet-shaped mouths. The fan is worked by any suitable motive power, and air being drawn into the fan is driven through the tubing and out into the open air, thus reacting on the balloon and propelling it.

ELECTRICITY.—Messrs. W. Lowrie and C. J. Hall and H. W. Kolle have patented means for measuring alternating currents of electricity. When measuring the current deviation of a number of lamps in a lighting circuit a voltaic cell is placed in the circuit. This cell comprises two dissimilar metals placed in an acid. When the current is passed through it and the circuit the flow of the current is alternately retarded or assisted by the cell, causing a waste of the positive electrode. The current which acts upon the electrode varies, and is directly proportional to the electro-motive force of the cell and the resistance of the lamp circuit; the action of the cell, therefore, is available as a current measure.

ENGINES.—Mr. H. Jarman has patented improvements in high-speed revolving multiple cylinder engines. According to this invention, a revolving cylinder engine is provided, consisting of three or more single-acting cylinders enclosed in a stationary casing and disposed radially around and fixed to the engine-shaft, and provided with pistons having connecting-rods jointed thereto, and working jointly upon a fixed pin which is eccentric to the centre of the shaft, the casing having a bearing for the shaft and a trunnion bearing for the cylinders, the latter revolving on the trunnion, which is provided with steam ports corresponding with ports in the cylinder-bearing part.

STEEL OR IRON.—Mr. J. H. Darby has patented improvements in the manufacture of steel or iron. The metal is run from the open hearth furnace into a ladle fitted with an ordinary nozzle and stopper to regulate the flow. From the ladle the metal flows through a filter from which the metal takes up carbon. From the filter it runs into another ladle, in which it is allowed to stand, covered with small pieces of charcoal for a short time before being cast or returned to the furnace and submitted to a reducing heat. While in the furnace charcoal is spread over it, and the metal is left until the desired temperature and temper are attained, after which it is tapped in the usual way.

ELECTRIC LIGHT.—Mr. E. F. H. Lauckert has patented apparatus for indicating the time during which electricity is used for a lamp or other purpose. A counter mechanism is provided for each lamp; this counter is of any suitable kind, and is connected with clockwork by a magnetic clutch, which may consist of a pair of iron bosses facing each other, the one on an axle driven by clockwork, and the other on an axle belonging to the counter, both bosses being surrounded by a coil of wire forming part of the circuit of the lamp. When a current passes through the coil the two bosses are held together by magnetic attraction, and the counter is operated. When the current ceases the clutch is released and the counter stops registering.

CITY OF LONDON COLLEGE.—On Thursday last, the 6th inst., a visit of the Science Society to the Millwall Docks was arranged by Mr. Henry Adams, M.Inst.C.E., who accompanied the members. Mr. F. E. Duckham, the engineer to the Dock Company, met the party at the railway station, and was most assiduous in showing and explaining the many interesting details with which the dock abounds. Among the points noted were some economically built sheds with compound iron and wood roof trusses, and other very light galvanised roofs of 60 ft. span. When first opened the dock was fitted with fixed hydraulic cranes on the quay; these have been supplemented by portable hydraulic cranes, which are found much more convenient, and they have since been largely adopted elsewhere. The arrangement of the pipe mains was explained, and the method by which a breakage at any point could be shut off by means of stop-valves, so as to permit the machinery at other parts to continue working. Branches at intervals allow connection to be made with the portable cranes, and the telescopic pipes provided give a considerable range of movement. The grain machinery was next inspected with the automatic weighing-gear and self-emptying buckets, and Mr. Duckham's pneumatic apparatus for discharging mud from the dredger barges was seen in operation. Much interest was taken in the hydraulic engine-house and the various pumping appliances, which were fully explained to the visitors. To prevent damage to the engines an ingenious self-acting relief-valve is used, by which a large area is opened to allow the pressure-water to flow back into the tank when the accumulator reaches the top of its stroke and the draught of water from the main is suddenly reduced. The graving dock was fortunately empty, so that its construction could be seen, together with the flat-sided caisson at its entrance, a large ship being on the blocks in course of scraping and painting; and the noted 75-ton shears, by Messrs. Day and Sumner, of Southampton, were observed with some interest owing to that subject having been set for the home work of students in machine construction at the last May examination of the Science and Art Department. By the courtesy of Messrs. MacDougal, their extensive wood-fibre paper-making plant was next seen in operation, from the arrival of the spruce fir-logs at one end to the packing of the bales of finished paper at the other. The whole of the processes were in full swing, but an intimation was given that the visit was considered to be "private and confidential."

DIARY FOR NEXT WEEK.

Monday, Dec. 17.—Society of Arts, John Street, Adelphi, Cantor Lecture, at 8 p.m.—*Light and Colour*, by Captain W. de W. Abney, C.B., F.R.S.

Tuesday, Dec. 18.—Zoological Society, 3, Hanover Square, W., at 8.30 p.m.—*Descriptions of Fifteen New Species of Shells from China, Japan, and the Andaman Islands, chiefly collected by Deputy Surgeon-General R. Hungerford*, by Mr. G. B. Sowerby, F.Z.S.—*List of the Lepidoptera-Heterocera, with Descriptions of the New Species, collected by Mr. C. M. Woodford at Aola, Guadalcanar Island, Solomon Islands*, by Mr. Herbert Druce, F.Z.S.—*On the Lepidoptera of Japan and Corea. Part II. Heterocera*, by Mr. J. H. Leech, F.Z.S.—*Some Remarks on the Numbers and on the Phylogenetic Development of the Remiges of Birds*, by Dr. Hans Gadow.

Institution of Civil Engineers, 25, Great George Street, Westminster, at 8 p.m.—*The Friction of Locomotive Slide Valves*, by Mr. J. A. F. Aspinall, M.Inst.C.E.

Royal Statistical Society, School of Mines, 28, Jermyn Street, W., at 7.45 p.m.—*Recent Changes in Prices and Incomes Compared*, by Mr. Robert Giffen, LL D.

Wednesday, Dec. 19.—Civil and Mechanical Engineers' Society, Westminster Palace Hotel, at 7 p.m.—*Notes on the Oroya Railway, in Peru.*

Society of Arts, John Street, Adelphi, at 8 p.m.—*Standards of Light*, by Mr. W. J. Dibdin, F.I.C.

Royal Meteorological Society, 25, Great George Street, Westminster, at 7 p.m.—*Note on the Prolonged Spell of Cold Weather from September*, 1887, *to October*, 1888, by Charles Harding, F.R.Met.Soc. *Report on the Phenological Observations for* 1888, by the Rev. T. A. Preston, M.A., F.R.Met.Soc.—*A Winter's Weather at Massowah*, by Captain D. Wilson-Barker, F.R.Met.Soc.

Thursday, Dec. 20.—Chemical Society, Burlington House, at 8 p.m.

Manchester Microscopical Society, at 7 p.m. Mounting Section.

St. James's Hall, at 8.30 p.m.—*Lecture on Architecture*, by Messrs. G. A. T. Middleton and Cecil Orr.

NOTICES.

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METEOROLOGICAL RETURNS

For the ten weeks ending on Monday, Dec. 3rd, 1888. Specially prepared for SCIENTIFIC NEWS from official reports.

	Mean Temperature.	Rainfall.	Duration of Sunshine.
Scotland, East	44·4 degs., being 2·0 degs. above average.	8·4 ins., being 1·1 ins. above average.	95 hrs., being 85 hrs. below average
England, N.E.	46·3 ,, ,, 1·2 ,, ,, ,,	5·1 ,, ,, 1·4 ,, below ,,	138 ,, ,, 20 ,, ,, ,,
England, East	46·4 ,, ,, 0·1 ,, below ,,	4·8 ,, ,, 1·5 ,, ,, ,,	190 ,, ,, 2 ,, ,, ,,
Midlands ...	46·0 ,, ,, 0·4 ,, above ,,	6·1 ,, ,, 0·7 ,, ,, ,,	165 ,, ,, 13 ,, ,, ,,
England, South	48·0 ,, ,, 0·8 ,, ,, ,,	7·5 ,, ,, 0·5 ,, above ,,	174 ,, ,, 11 ,, ,, ,,
Scotland, West	46·4 ,, ,, 1·3 ,, ,, ,,	13·0 ,, ,, 1·6 ,, ,, ,,	117 ,, ,, 43 ,, ,, ,,
England, N.W.	47·1 ,, ,, 0·2 ,, ,, ,,	8·7 ,, ,, 0·3 ,, below ,,	131 ,, ,, 24 ,, ,, ,,
England, S.W.	49·1 ,, ,, 0·7 ,, ,, ,,	11·3 ,, ,, 0·5 ,, above ,,	177 ,, ,, 15 ,, ,, ,,
Ireland, North	48·1 ,, ,, 1·5 ,, ,, ,,	7·8 ,, ,, 0·6 ,, below ,,	137 ,, ,, 36 ,, ,, ,,
Ireland, South	49·1 ,, ,, 1·4 ,, ,, ,,	9·2 ,, ,, 0·5 ,, above ,,	146 ,, ,, 49 ,, ,, ,,
The Kingdom...	47·1 ,, ,, 0·9 ,, ,, ,,	8·2 ,, ,, 0·03 ,, below ,,	147 ,, ,, 30 ,, ,, ,,

Scientific News

FOR GENERAL READERS.

VOL. II. | DECEMBER 21, 1888. | No. 25.

CONTENTS.

SCIENTIFIC TABLE TALK.

By W. MATTIEU WILLIAMS, F.R.A.S., F.C.S.

THE structure of the interior of the earth is a much-vexed question. Direct evidence, derived from penetration of its crust in the operations of well-sinking, mining, etc., shows that its temperature gradually increases as we proceed downwards, without presenting any indication of a limit to such increase. On such data calculations have been made, showing that at a very moderate depth, *i.e.*, moderate in relation to the dimensions of the earth, materials such as compose its crust must exist in a state of fusion, and therefore the earth, regarded as a whole, is a fluid mass, encased in a solid crust the relative thickness of which may be compared to that of the rind of an orange as compared with the whole fruit.

Opposed to this we have the speculative deductions of certain mathematicians—Hopkins, Mallet, Sir W. Thomson, Prof. G. H. Darwin—and others, who maintain, on astronomical grounds, that the earth is solid throughout, with a rigidity about equal to that of a globe of steel, supposed also to be solid throughout. Hennesey, Delaunay, Sir G. B. Airy, and others arrive at an opposite conclusion, as a result of calculations based on the same data. This is not at all surprising, considering the refinement of the data, viz., the deformation of the earth as indicated by its nutation, and the precession of the equinoxes.

The researches of W. Spring, which have been in progress during the past eight or ten years, have rendered us no longer dependent on these inverted pyramids of complex calculations. He has proved by direct experiment that the materials of which the earth's crust is composed, when subjected to a compression corresponding to that which they suffer at a few miles below the surface, assume a fluid condition, and that this occurs at ordinary temperatures, though, of course, it is aided by heat.

He finds that lead filings, under a pressure of 2,000 atmospheres, unite into a firm block, which under the microscope exhibits no trace of the original filings, but presents all the appearances of a cast block; that under a pressure of 5,000 atmospheres the lead oozed out at the joints of the apparatus. A mixture of filings of bismuth, tin, and cadmium, in the proportion to form Wood's fusible alloy, when similarly compressed, interfused with each other, forming the alloy, which melted at 158° Fahr., the mean melting-point of its constituents being 468°. This shows true combination throughout. Copper and zinc similarly treated produced brass; magnesium, zinc, bismuth, lead, silver, copper, tin, and antimony, when mixed with sulphur and subjected to a pressure of 6,500 atmospheres (97,500 lbs. to the square inch), formed true sulphides. In all these cases there was an interflowing of substances usually described as solids.

A similar fluidity is momentarily produced in operations of coining and die-sinking. The metal flows into all the hollows of the die, as water would flow if poured upon it. The water flows in obedience to the slight pressure of its own weight, but the metal demands a much greater pressure. This, as it appears to me, is the essential difference between the two cases. Solidity and fluidity are but relative terms. We know of nothing that is absolutely rigid, nor of any absolutely fluid matter, *i.e.*, of no liquid nor gas that flows without some degree of viscosity or internal friction.

A pressure of 6,500 atmospheres corresponds to that to which the material of the earth is subjected at about 80,000 feet depth below the surface, *i.e.*, fifteen miles in round numbers, or $\frac{1}{528}$ part of the earth's diameter. On a globe of one foot diameter this depth is proportionally represented by a thickness of less than $\frac{1}{44}$ part of an inch, or that of a stout card, and yet there can be little doubt that the combined action of the increased temperature with the pressure must liquefy such materials as those of which the crust of the earth is composed.

Nevertheless, we need not be afraid of breaking through this pellicle of rock-ice as we travel over it, for the essential character of such fluidity, as Spring has demonstrated, is that it is only manifested under enormous pressure. Sir W. Thomson may possibly say that the demand for such a shearing force to effect fluidity constitutes a degree of rigidity corresponding to that of steel.

In selecting such a substance as steel for his standard of rigidity Sir W. Thomson has either intentionally or inadvertently chosen about the most variable solid, as regards rigidity, that exists. Its composition varies from soft steel, containing $\frac{1}{3}$ per cent. of carbon, to hard crucible steel, running up to 3 per cent., or nine times as much, its rigidity varying in similar proportion. Moreover, the same piece of steel varies through a still wider range of rigidity according to whether it is slowly or rapidly cooled. Ordinary tool steel, when annealed, may be beaten, or rolled, or "spun" into almost any shape. I have before me a steel vase, 4 inches high, and 2 inches in diameter at its widest part, shaped with foot, etc., that was hammered and spun into its present shape from a flat circular disc of rolled metal. On the other hand, if tool steel be made red-hot and suddenly cooled it becomes so hard and rigid that it will cut glass, and may not be bent at all without fracture. This same piece may be tempered through all the well-known gradations down to the softness and plasticity above described. It may be that Sir W. Thomson carefully considered these facts in order to be quite safe in stating, as the result of his calculations, that the rigidity of the earth nearly corresponds to that of steel.

That the earth, regarded as a whole, is elastic and fluid, or viscous, in the sense I have described above, is proved by the simple fact that great and small waves are propagated in the course of earthquakes, and that when the pillars of coal-mines are removed the roof of rock sinks down and the floor "creeps," up, this occurring in many cases without any fracture.

Describing the Jamaica earthquake of 1692, Lyell says, "A tract of land round the town, about a thousand acres in extent, sank down in less than one minute, during the first shock, and the sea immediately rolled in. The *Swan* frigate, which was repairing in the wharf, was driven over the tops of many buildings, and then thrown upon one of the roofs, which it broke." He also tells us that "the surface of the country during the Calabrian earthquakes often heaved like the billows of a swelling sea, which produced a swimming in the head like seasickness. It is particularly stated, in almost all the accounts, that just before each shock the clouds appeared motionless; and although no explanation is afforded of this phenomenon, it is obviously the same as that observed in a ship at sea when it pitches violently. The clouds seem arrested in their career as often as the vessel rises in a direction contrary to their course; so that the Calabrians must have experienced precisely the same motion on land."

In the report of the Committee appointed by the British Association (1885) to investigate earthquake phenomena in Japan, some very curious facts are stated. One of the instruments used for measuring the movements of the earth was carried to the summit of Fujiyama, a mountain 12,365 feet high, and it was found that the effects of the earth-waves' movements were there exaggerated, as is the rolling of a ship at the summit of its masts. But this was not all; the delicate level indicated that when a strong wind was blowing the bed-plate of the instrument was tipped upwards on the side from whence the wind was blowing, indicating a leaning over of the mountain due to the wind-pressure, as though the base of the mountain was temporarily thrust downwards into the yielding cushion of its rock-bed, on the side where the force of the wind temporarily increased its pressure, *i.e.*, on the side opposite to that from which the wind was blowing.

ASTRONOMY IN CHINA: THE PEKIN OBSERVATORY.

FIG. 3 shows that for observations the Chinese astronomers make use of a ladder on rollers, analogous to those employed in European observatories, and moving upon a double rail. But we must not honour the Chinese imagination for this improvement, for the ladder appears of recent construction, so has probably been imported from Europe.

There are, further, upon the terrace an armillary sphere, an equinoxial sphere, and a celestial sphere of six feet in diameter (fig. 4). This last instrument attracted the admiration of Father Lecomte, and is, in fact, very remarkable. All the stars are shown in relief in their proper places. It is so well suspended that a child could turn it in the direction of the diurnal movement, though it weighs 2,000 lbs.

He describes the ornaments shown in the figure, and

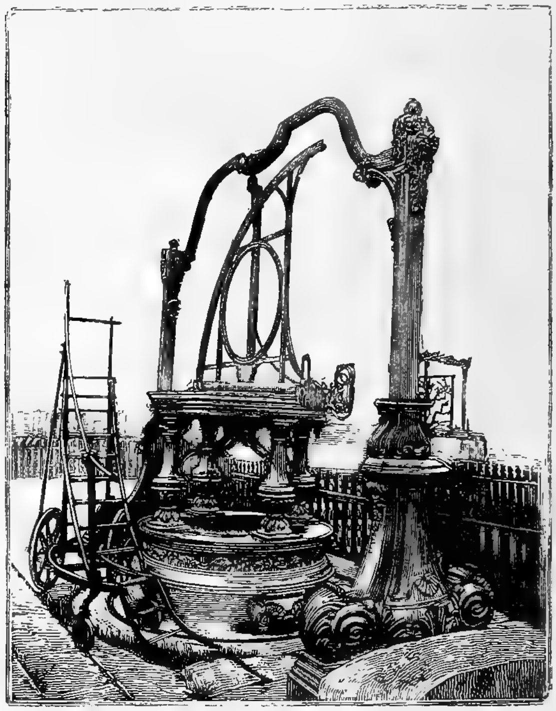


FIG. 3.—OBSERVATORY LADDER.

the concealed wheel-work which gives the axle any desired inclination.

One of the most remarkable instruments is the gnomon, analogous to that used by Kuo-Shou King, astronomer to the Emperor Kublai Khan, founder of the first Tartar dynasty and creator of the first Tartar dynasty. This astronomer used it for executing certain observations, of which Laplace speaks in laudatory terms in his *Mécanique Celeste.*

In addition to the instruments just named, we figure a very ancient armillary sphere dating back to the thirteenth century (fig. 5). The inevitable bronze dragons supporting it are remarkable for their delicacy of execution. Father Verbiest effected a reorganisation of the observatory in 1670, very near the time (1667) when Dominic Cassini created the Observatory of Paris for Louis XIV. He removed the instruments of Kuo-Shou King, most of which still exist, and which have been recently photographed. They differ from those of Father Verbiest chiefly by their profusion of ornaments and by being less easily handled. They are graduated in 365 degs., so that the sun traverses daily one of their degrees. They are similar to those which Tycho constructed at his observatory in the Isle of Huen, with

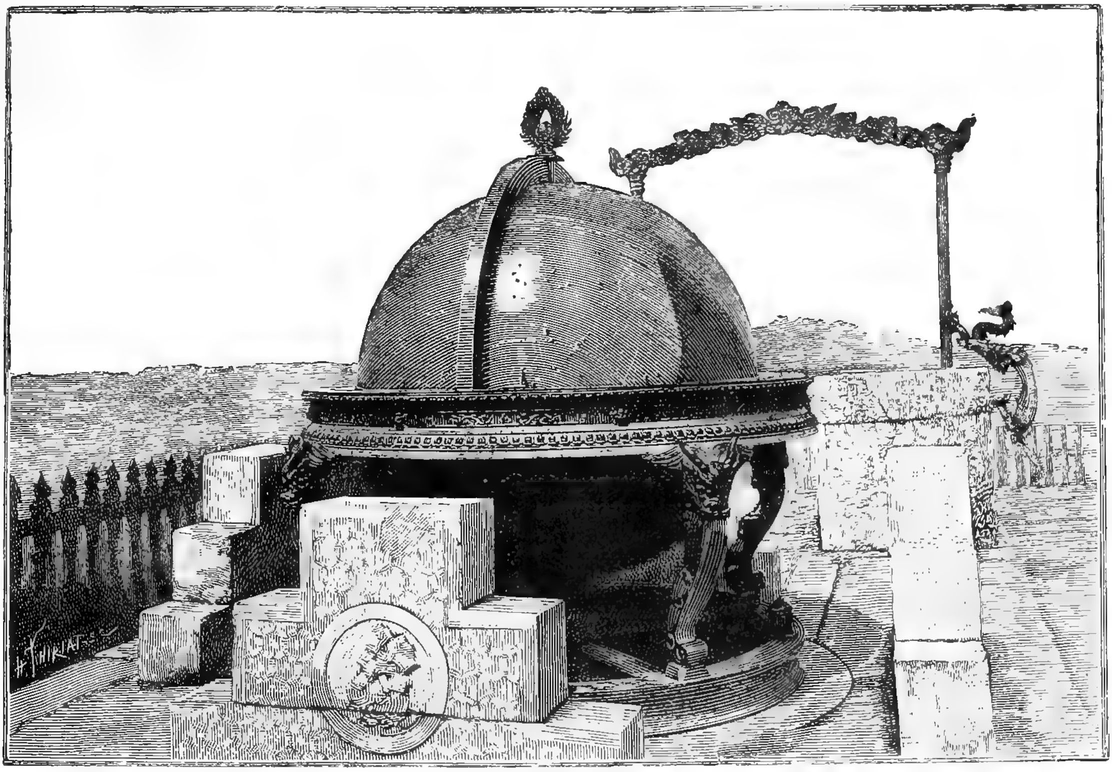


FIG. 4.—CELESTIAL SPHERE (6 FT. IN DIAMETER).

which he observed up to the end of the sixteenth century. They only differ from modern instruments because in these latter the sights have been replaced by telescopes which the Chinese do not want, and of which they have no need.

Father Verbiest, the second creator of the Observatory of Pekin, died in that city exactly two centuries ago.

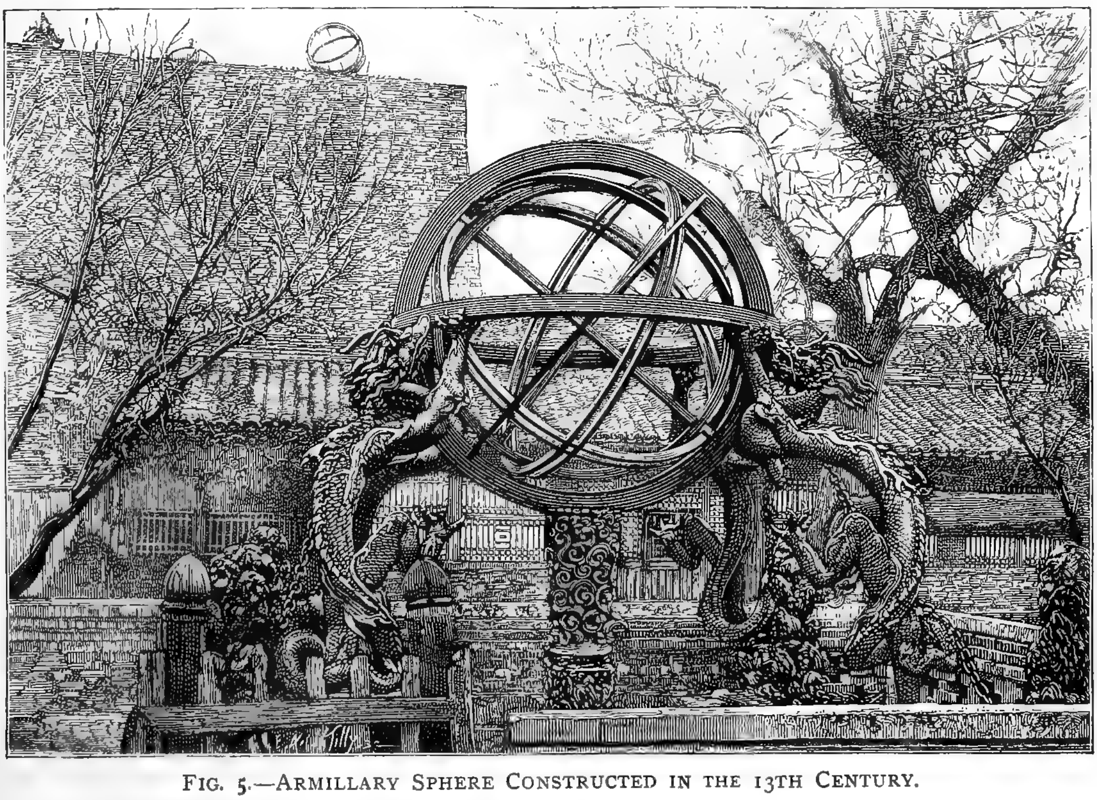


FIG. 5.—ARMILLARY SPHERE CONSTRUCTED IN THE 13TH CENTURY.

SOME RECENTLY DISCOVERED FORMS OF MICROSCOPIC CRUSTACEA.

(*Part II., continued from p.* 598.)

ALTHOUGH our British species of Copepoda present a large variety of form, they must for colour and size yield the palm to foreign species, and it is now proposed to describe a few recently discovered forms obtained last year, during a biological visit to Madeira and the Canary Islands. Over sixty varieties were found about these islands, some adorned with brilliant hues, which are still preserved after being mounted on slides as microscopic objects.

The majority of them are well figured and described in Dr. Brady's excellent *Challenger* monograph on the Copepoda, six, however, being new to science, of

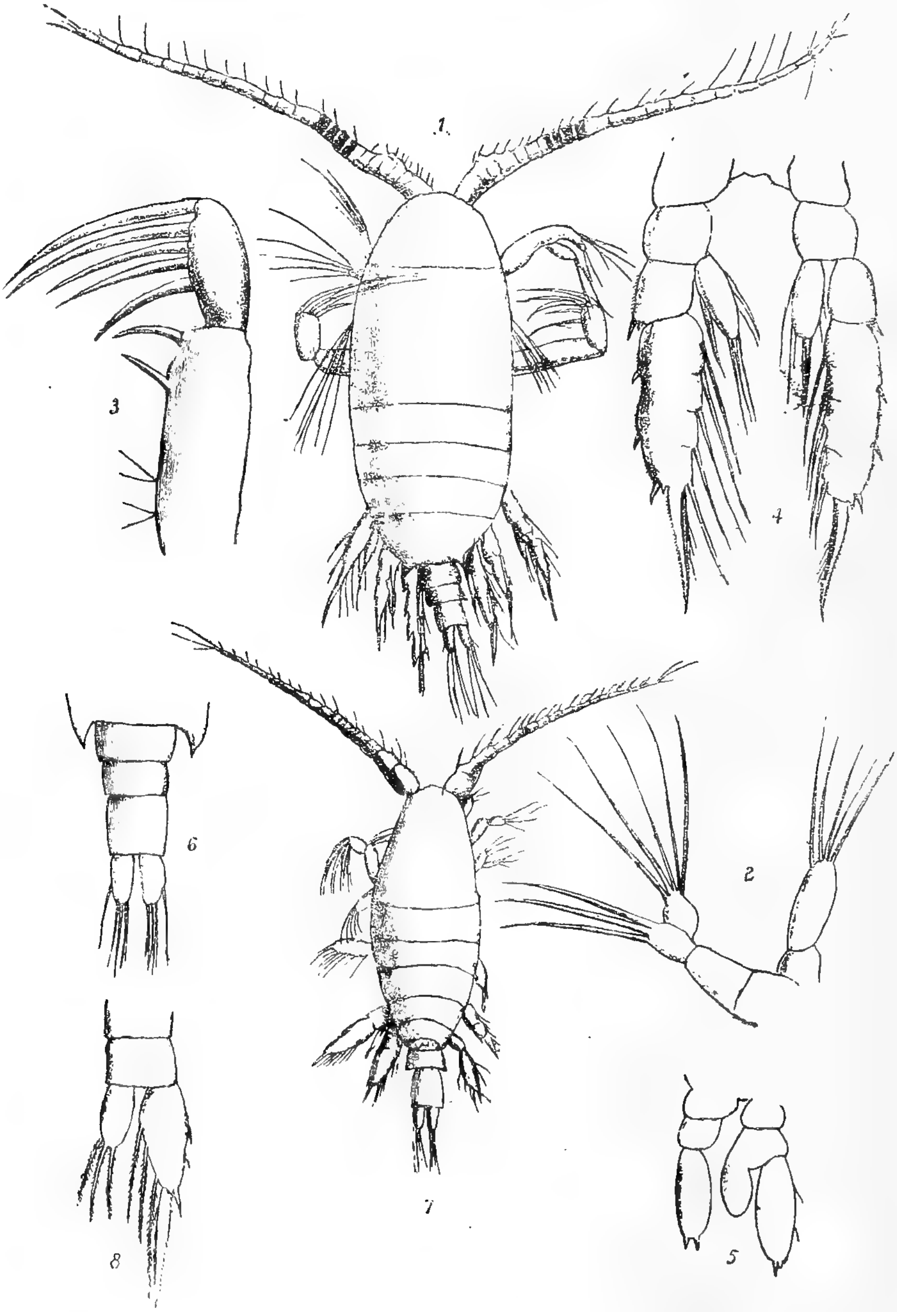


PLATE IV.

Fig. 1. *Candace nigrocincta*, I.C.T., male. × 250.
Fig. 2. Posterior antenna of ditto. × 400.
Fig. 3. First foot-jaw of ditto. × 400.
Fig. 4. Fourth pair swimming-feet of ditto. × 400.
Fig. 5. Fifth pair swimming feet of ditto. × 400.
Fig. 6. Abdomen and caudal segments of ditto. × 400.
Fig. 7. *Candace brevicornis*, I.C.T., female. × 250.
Fig. 8. Fourth swimming-foot of ditto. × 400.

which a description and figures are here given. There appears to be but little difference as regards their geographical distribution amongst the various islands, although much more plentiful in the sheltered bays and harbours than in the more exposed open sea.

Candace nigrocincta, I.C.T., plate iv. The genus Candace is characterised by the presence of dark black pigment markings in various parts of the animal's body, the black rings on the antennæ of this species being sufficient to distinguish it from those hitherto known.

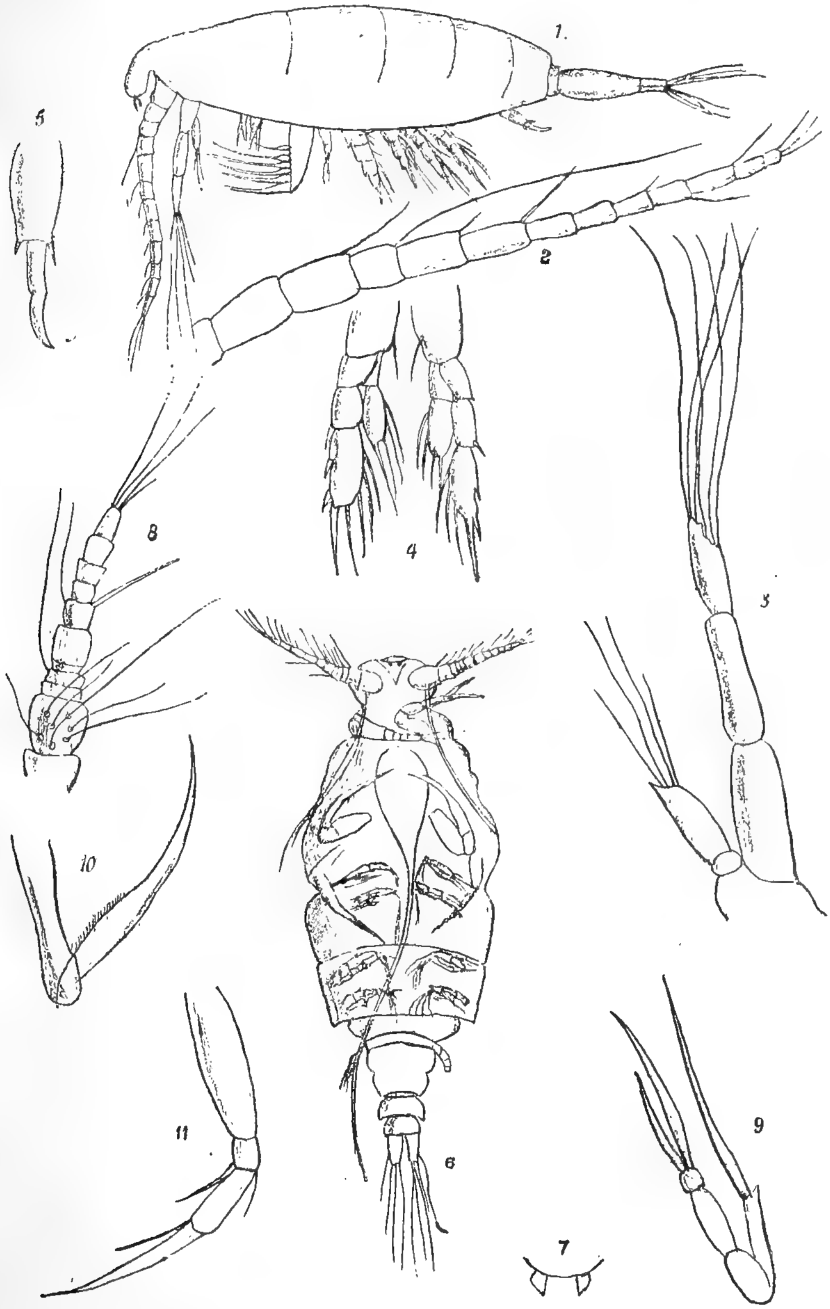


PLATE V.

Fig. 1. *Machairopus Sanctæ-crucis*, I.C.T. ×250.
Fig. 2. Anterior antenna of ditto. ×400.
Fig. 3. Posterior antenna of ditto. ×400.
Fig. 4. Fourth pair swimming-feet of ditto. ×25.
Fig. 5. Fifth swimming-foot of ditto. ×250.
Fig. 6. *Acontiophorus angulatus*, I.C.T., female, ×250.
Fig. 7. Rostrum of ditto. ×400.
Fig. 8. Anterior antenna of ditto. ×400.
Fig. 9. Posterior antenna of ditto. ×400.
Fig. 10. Anterior foot-jaw of ditto. ×400.
Fig. 11. Posterior foot-jaw of ditto. ×400.

Its length is about $\frac{1}{16}$ inch. The body is oval, and rounded in front. The posterior segments are terminated by two lateral spines. The anterior antennæ are 23-jointed, bearing several spinous processes on the inner margin, and short setæ at the termination of each joint. The 8th, 9th, 10th, and 11th joints (fig. 1) are deeply pigmented with a blackish-brown colour, the same pigment tinging the setæ of the posterior antennæ and the terminal spines of the swimming feet. The posterior antennæ (fig. 2) are similar to those of *C. truncata*, but with fewer terminal setæ. The anterior foot-jaws (fig. 3) are 2-jointed, large, and powerful, with two small claw-like spines on the basal joint, and five large ones on the second joint. The posterior foot-jaws are small and 7-jointed. The first four pairs of swimming feet (fig. 4) are alike; the inner branch has one joint only; the outer edge of main branch is finely serrated. The pigment does not extend above the terminal spine, which is somewhat bent and finely serrated, and clothed with dark hairs on the dorsal side. The fifth feet of the male (fig. 5) are each 3-jointed, the right foot having extension on the inner side of the middle joint, both being terminated by two small claws. The abdomen of the male (fig. 6) is 3-jointed, the third being nearly equal in size to the other two; the caudal segments are about twice as long as broad, and are terminated by short, strong setæ.

Several specimens of this strongly marked form were taken at Orotava, Teneriffe, all of which appear to be males.

Candace brevicornis, I.C.T., plate iv. A much more diminutive form than the last, and characterised by its antennæ being 18-jointed instead of 23 or 24, as is the case with most of the genus.

Machairopus Sanctæ-crucis, I.C.T., plate v. One specimen only was taken by tow-net at Santa Cruz, Teneriffe. Length, $\frac{1}{18}$ inch. The rounded head (fig. 1) is of a deep pink colour. The anterior antennæ (fig. 2) are 12-jointed. The posterior antennæ (fig. 3) have long, whip-like setæ, extending to the length of the anterior antennæ. The swimming feet (fig. 4) have three joints to the outer branch, and two joints to the inner. The terminal spine is narrow and finely serrated. The basal joints of the swimming feet have long spine on the inner margin. The fifth feet (fig. 5) have one joint, terminated by a long, stout, curved spine, with a small one at each side. The first joint of abdomen is small, the second long, and wide in the middle. The caudal segments are about four times as long as broad, and are terminated by short, non-plumose setæ.

Acontiophorus angulatus, I.C.T., plate v. One specimen only of this new species was taken at Funchal Bay, Madeira. The angular shape of the posterior segments of the cephalothorax readily distinguish it from *A. scutatus*, which it resembles in general characters.

Length, $\frac{1}{30}$ inch. The anterior antennæ are 11-jointed short, and gradually tapering from base to apex; the posterior antennæ (fig. 9) are 2-branched, the first being 3-jointed and terminated by two long, lancet-shaped spines; the second has one joint, and is terminated by a long, sword-shaped spine. First and second foot-jaws (figs. 10 and 11) each have a long apical claw; the first is composed of two, the second of four joints.

First four pairs of swimming feet nearly alike, both branches being 3-jointed (plate vi., fig. 5); the base and second joint of the chief branch have very fine serration on inner edge, formed by minute hairs. Fifth feet (plate vi., fig. 6) are composed of two stout joints, the outer bearing a number of long setæ, some of them plumose; the outer edge of both joints has fine hairy serration.

Siphon very long and slender, reaching to the ends of caudal segments.

(To be continued.)

MEMORANDA.

Of all mechanical modes of assisting study, perhaps none are so important as wise methods of making and preserving notes. The commonplace book of the old scholars is the most obvious receptacle for scraps of knowledge, but not at all the best. The habit of transcribing passages without the alteration of a word gives dryness to the style, and in the long run to the mind. Examples could be quoted to show that pleasure comes at last to be taken in the mere occupation of copying, however unimportant the remarks may be. Southey's "Commonplace Book," copies of which used to load the shelves of secondhand booksellers, shows what may become of a student who gives way to the passion of accumulating curiosities. We must never forget that the end in view is not the production of a neat book of extracts, nor any kind of learned trifling, but the concentration into manageable form of the products of genuine thought, and that thought in some sense our own. Let us not suffer the love of pigeon-holing to overpower, as it easily may, the love of research. What is wanted is a rapid and flexible system, which can alter with altering needs, and greater experience, and by means of which we can bring into one view the results of years of reading and observation. Perhaps no better methods can be recommended to the young student than those practised with such memorable results by Charles Darwin. The first and simplest resource is to fasten a sheet or two of paper into any book which contains materials likely to be wanted hereafter, and write down the headings with references to the pages. Of works which are to be got up throughout abstracts must be made. Let the abstract be brief and carefully arranged to avoid repetition as well as to promote quick examination. Nothing beyond a single sentence should as a rule be given in the words of the book, and even so much is rarely necessary. The inexperienced student must be ever on his guard to see that the work of the pen is not allowed to stand for the close application of his mind to the subject. As materials accumulate, they want classification and storage. A range of shelves or drawers is wanted. We have found nothing better than Stone's cabinet for law-forms, which costs £3 12s., and will hold enough for a life-time of abstracting. As need arises, special indexes can be made, or the materials resorted. It is an indirect advantage, not to be lightly esteemed, that the student soon becomes used to note the heads of whatever he is interested in, and is led to adopt that useful maxim of Lagrange—"Always read pen in hand."

The Lily of the Valley Poisonous.—According to the *Revue Horticole*, the lily of the valley (*Convallaria maialis*) is a powerful poison for poultry. Of ten young hens which had been eating the flowers of this plant, nine died shortly after.

General Notes.

The Inhabitants of Ancient Egypt.—In opposition to the hypothesis that the people of Ancient Egypt were of a negroid type, Prof. Virchow shows that they were of old, just as at present, a straight-haired race.

The Sewage of Paris.—In spite of all the boasts concerning the fertilising properties of the Paris sewage, no one will have it. The last suggestion is a canal for taking it to the coast between the Somme and Arthe.

A New Chair of Botany.—Dr. Holbrook Gaskell has promised to the Liverpool College of the Victoria University the sum of £5,000 towards the endowment of the Chair of Botany. The total sum required will be £10,000.

Sweeping Adulteration.—At Stoke-upon-Trent "sublime olive oil" has been sold which consisted entirely of cotton-seed oil with a slight trace of some animal oil. There can be no objection to cotton-seed oil if sold under its own name.

The Satellites of Mars.—M. Poincarré, in a communication to the Academy of Sciences, calls in question the hypothesis of M. Dubois that the satellites of Mars are small planets which have passed some years back in the vicinity of Mars, and have been retained by the attraction of that planet.

Injurious Effects of the Telephone.—Dr. C. J. Blake (*Science*) has communicated to the American Otological Society a paper on the injurious effects of the telephone on the hearing power. He thinks that the ear is fatigued and rendered liable to injury. Other medical men present gave confirmatory evidence.

Executions by Electricity.—*Science*, commenting on the manner of applying the current as proposed by the Medico-Legal Society of New York, thinks that it should be passed from one arm to the other so as to traverse the region of the heart. In almost all the fatal accidents recorded the current has passed in this manner.

Interruption of Electric Conductions by Snow.—On November 9th, at the town of St. Joseph, in Montana, a heavy snowstorm first broke down the telegraph and telephone wires, and by 4 p.m. rendered the electric-light wires useless. The electric tram-lines, however, were not in the least interfered with, but went on working as usual.

The Persistence of Human Races.—According to Prof. Virchow (*Verhandl. Berlin. Gesellsch. für Erdkunde*), the hereditary persistence of races is so strong that it is maintained in spite of admixtures, and the ultimate fusion of individuals to one common type is not so much a product of the mixture as the elimination of some element out of the mixture.

A Chinese Soap.—According to Father A. Chausse (*Cosmos*), the favourite soap of the Chinese is the cake left after pressing out the oil from the seeds of *Camellia oleifera*, a near ally of the beautiful *Camellia japonica*, so much cherished in our conservatories. The cake is ground to powder and dissolved in boiling water, and is said even to take out oil-spots.

The Universal Meridian.—*Cosmos*, deeply dissatisfied, like many other French organs of opinion, with the proposed universal adoption of the meridian of Greenwich, again proposes Bethlehem as the first meridian! It is needless to say that a place which has no observatory and which lies outside the life of the present age is eminently unsuitable for such a purpose.

Rain in Greenland.—According to *Cosmos*, violent rains are not confined to the tropics. At Ivigtut, in the south of Greenland, a rainfall of seven inches was registered on October 12th and 13th, 1887. In December it rained without ceasing from the night of the 18th to the night of the 29th, the depth of the rain being above ten inches. During the last seven days the daily average was close upon an inch.

Progress of Cremation.—According to the *Flamme*, the organ of the Berlin Cremation Society, the number of bodies cremated in different countries up to August 1st last is, in Italy 998, Germany 554, America 287, Sweden 39, England 16, France 7, and Denmark 1. The members of the cremation societies number 3,012 in Sweden, 1,326 in Denmark, 1,326 in Holland, 1,050 in Germany, 580 in Italy, and 390 in Switzerland.

The Sanitary State of Manchester.—The medical papers are much exercised touching the high death rate of Manchester, which is pronounced to be more unhealthy by 70 per cent. than the average of other large towns in the United Kingdom. Whatever may be the cause, or causes, of this unsatisfactory state, it cannot be the soil or climate, since the rural districts a few miles to the west rank among the healthiest places on the earth.

A Subterranean River.—M. Martel informs the Academy of Sciences that he has recently performed a voyage of about $1\frac{1}{4}$ mile in the underground passages, in which circulates a stream which disappears in the region of Causses. The author's results lead him to propose a theory on the formation of the celebrated *canons* such as are met with in the State of Colorado, and, although on a smaller scale, in France, at Montpellier-le-Vieux.

Dreams of the Blind.—Jastrow (*Humboldt*) has recently confirmed the conclusions of G. Herrmann that persons who have lost their eyesight prior to their seventh year never dream in visual imagery, whilst in those who have become blind later in life the dreams are like those of persons who can see. Jastrow believes that the blind dream unusually little, women more than men. Dreams decrease in frequency from childhood to age.

The Sight-Seer's Headache.—The *New York Medical Record* examines the origin of this affection so well-known to the visitors of museums, picture-galleries, and exhibitions. The principal causes seem to be a close atmosphere, defective in ventilation, the mental fatigue from long-continued observation, and the bodily weariness from maintaining an upright position, and especially the strain from continually moving the head and the eyes in an upward position.

MICROBIA IN ARTIFICIAL MINERAL WATERS.—Hochstetter (Humboldt), after examining samples of such waters for the German Imperial Sanitary Department, finds that pathogenic (disease-producing) micro-organisms die in course of time if kept in closed bottles. The propagation of cholera by water which has been in stock for some days is improbable, but an epidemic of typhus may be produced by water which is from five to seven days old.

INFLUENCE OF EXERCISE UPON DIGESTION.—Dr. Kohn has recently conducted a series of experiments in the laboratory of Professor Rossbach to decide whether rest or exercise after a meal is more favourable to digestion. The results showed that exercise decidedly retards digestion, leading to the production of large quantities of lactic acid in the stomach, while hydrochloric acid and peptone were much below their normal proportions.

POISONOUS EFFECTS OF CIGARETTE SMOKING.—Dr. W. L. Dudley, Professor of Chemistry in the Vanderbilt University of Nashville, gives, in the *Medical News*, an account of his researches on this subject. He finds that the most poisonous constituent of tobacco-smoke is carbonic oxide. More injury results from cigarette than from cigar or pipe smoking, because, as a rule, the smoke of the former is inhaled. Without inhaling, the cigarette is not more hurtful than the pipe or the cigar.

CLASSIFICATION OF LIGHTNING.—Arago divides lightning into three classes:—(1) Zigzag lightnings, or those of the first class, their name indicating their form, and sometimes splitting up into two or three branches. (2) Lightnings of the second class. The light of these flashes, instead of being concentrated in winding lines almost without breadth, covers vast surfaces. They often seem to illuminate the outlines of the clouds from which they emanate. (3) Lightnings of the third class, which take a globular form.

BLACK RIVERS OF SOUTH AMERICA.—Among the tributaries of the Amazon and the Orinoco there are several so-called *rios negros*—streams of the colour of coffee without milk. During his exploration of those regions M. Marcagno collected several samples of these waters and sent them to Professor Müntz for analysis. The colouring matter consists entirely of free humic matters in the proportion of 16 parts per million. There is scarcely any mineral matter, lime is totally absent, and there are mere traces of potash and oxide of iron. If a black stream falls into an ordinary river, the dark colour disappears at once.

PREPARATION OF PHOSPHORESCENT MATERIALS.—According to M. Becquerel, very small quantities of foreign matter incorporated with the alkaline earthy sulphurets greatly modify the character of the light emitted after exposure to the rays of the sun. Thus, with traces of peroxide of manganese, a fine yellow light is obtained; with persulphuret of potassium a green, and with compounds of bismuth a blue. An absolutely pure sulphuret of calcium gives off only a feeble light, which soon fades away. This shows the reason why the shells of oysters, etc., after calcination with sulphur, give a more phosphorescent mass than any pure carbonate of lime.

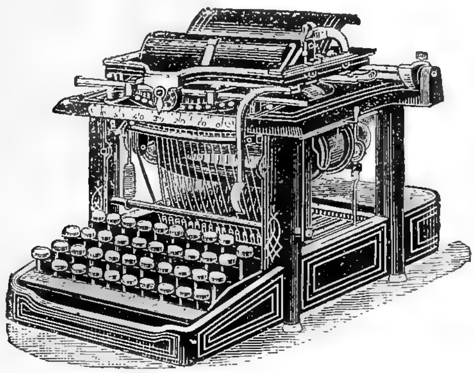
THE SALE OF MUSHROOMS.—According to *Cosmos*, the Council of Hygiene of Paris is about to adopt special measures to prevent the sale of unwholesome or poisonous fungi. It is proposed that all wild mushrooms shall be sold wholesale only at one market, where they will be duly examined by experts before being supplied to the retail trade. Cultivated mushrooms require, and will receive, a much less severe examination. It will be forbidden to cry, sell, or hawk mushrooms in the streets, or from door to door.

PREVENTION OF HYDROPHOBIA IN BAVARIA.—In the kingdom of Bavaria, during the years 1863 to 1876, there were annually at least 14 cases of hydrophobia out of a population of $5\frac{1}{2}$ millions, and in some seasons the number rose to 23, 29, and even 31. Since the introduction of a new law the number of such fatalities has been *three* in seven years. Every dog must, on pain of being immediately destroyed, have a responsible owner, and must wear round its neck a metal collar on which is engraven a receipt for the tax. The tax is paid *monthly*, on which occasion the dog has to be produced for veterinary inspection.

PUBLIC HEALTH.—The deaths registered last week in twenty-eight great towns of England and Wales corresponded to an annual rate of 18·6 per 1,000 of their aggregate population, which is estimated at 9,398,273 persons in the middle of this year. The highest death-rates, measured by last week's mortality, were:—From measles, 1·7 in London, 1·8 in Leicester, 2·6 in Portsmouth, 2·7 in Leeds, 3·0 in Oldham, 3·2 in Salford, 3·8 in Liverpool, 4·8 in Blackburn, and 7·7 in Cardiff; from scarlet fever, 1·0 in Liverpool and in Sheffield, 1·6 in Derby, and 2·2 in Blackburn; from whooping-cough, 1·0 in Birmingham and 1·9 in Cardiff; and from fever, 1·0 in Cardiff and 1·6 in Salford. The 48 deaths from diphtheria in these towns included 35 in London, 3 in Nottingham, 2 in Birmingham, 2 in Salford, and 2 in Newcastle-upon-Tyne. No death from small-pox was registered in any of the twenty-eight great towns. In London 2,644 births and 1,461 deaths were registered. Allowing for increase of population, the births were 41, and the deaths 357, below the aveage numbers in the corresponding weeks of the last ten years. The annual death-rate per 1,000 from all causes, which had been 17·2 and 16·5 in the two preceding weeks, rose last week to 17·8. During the first ten weeks of the current quarter the death-rate averaged 18·6 per 1,000, and was 1·7 below the mean rate in the corresponding periods of the ten years 1878-87. The 1,461 deaths included 139 from measles, 30 from scarlet fever, 35 from diphtheria, 13 from whooping-cough, one from typhus, 12 from enteric fever, 19 from diarrhœa and dysentery, and not one from small-pox, ill-defined forms of continued fever, or cholera; thus, 249 deaths were referred to these diseases, being 24 above the corrected average weekly number. In Greater London 3,494 births and 1,764 deaths were registered, corresponding to annual rates of 33·0 and 16·7 per 1,000 of the estimated population. In the Outer Ring 12 deaths from measles, 9 from diphtheria, 4 from scarlet fever, and 4 from "fever" were registered. Measles caused 5 deaths in West Ham and 3 in Willesden sub-districts. Two deaths from scarlet fever occurred in Enfield, and 4 from diphtheria and 3 from "fever" in Tottenham sub-districts.

TYPE-WRITERS.

MOST persons who can combine a little mechanical ability with a knowledge of the use of tools and of the construction of machinery, and who have also had some experience with type-writers, must marvel at the ingenuity, skill, and dogged perseverance of those who



THE REMINGTON TYPE-WRITER.

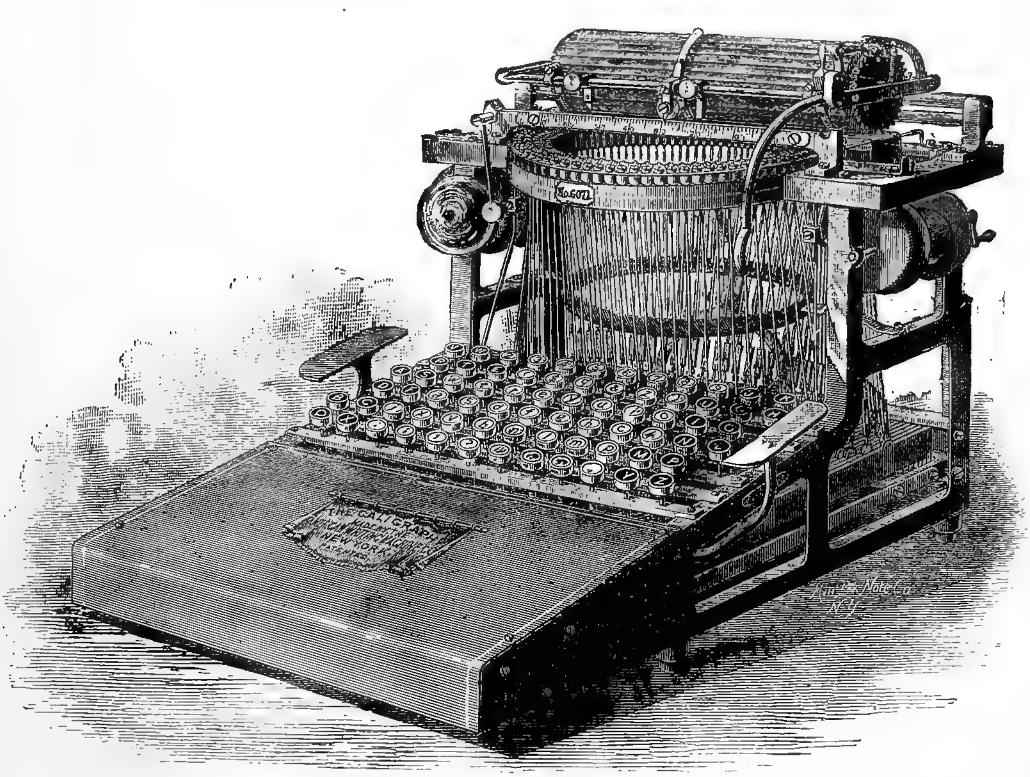
first attempted to produce a machine for writing in printed characters, and who succeeded in producing anything better than a troublesome toy.

Some amateurs are endowed with a delicacy of manipulation and patience that is seldom to be found in a skilled workman; and the fruits of their labours are often nothing more than marvellous ivory pagodas, balls within balls, and snuff-boxes whose beauty is rivalled only by their uselessness. We have not yet met with one who has had the skill to make, much less to invent, a satisfactory type-writer. Americans are as much before us in bringing out and perfecting such things as type-writers and sewing machines, as they are behind us in locomotive and marine engine work.

The sewing-machine has not only taken the bread out of the mouths of thousands of needlewomen, but its use is far more injurious to those who remain, than sewing in the old-fashioned way. The type-writer, on the other hand, is rapidly creating a new industry which is eminently adapted to female labour.

Of the two main advantages offered by the type-writer, perhaps legibility is more important than speed. A few weeks' practice is sufficient to enable any one to write as fast with a machine as with a pen, and constant use will make it possible to attain some eighty words a minute, or about three times the speed of fast writing. The fatigue is far less, especially for long spells of several hours in succession. The legibility cannot be compared so readily; but a good machine, with well selected type, produces a sheet, which, though it may contain errors due to the attempt of the operator to work at too high a speed, almost equals ordinary print, and has the great advantage of perfect uniformity, each letter being distinct, with none of those endings in which the last few characters melt away into a wriggling line.

The best known type-writers are the Barlock, Crandall, Columbia, Hall, Hammond, Remington, and the World. This alphabetical order places one of the latest inventions at the top of the list, while the well-known Remington, of which greatest numbers have been made, appears last but one. These machines may be conveniently divided into two classes: the Remington, Hammond, Caligraph, Crandall, and Barlock, which are key machines, and the Columbia, Hall, and World, which have moving type wheels or



THE CALIGRAPH TYPE-WRITER.

plates, operated by means of an index. The former class are provided with keys arranged in rows like an organ.

The inking is effected by means of a tape or ribbon, which is gradually reeled off from one spool to another. The inking arrangements of the second class sometimes give a good deal of trouble; for though only requiring a few drops of aniline ink, such as is used for rubber stamps, they alter considerably with changes in the weather. The Hall, for example, supplied with ink specially prepared for it, may be in good condition in the evening, and the next morning, being rainy, the inking pad may have become so wet that the writing is quite blurred and blotted. There is, however, considerable convenience in being able to obtain ink almost anywhere for a few pence a bottle, compared with the key machines for which inked tapes are supplied, in some cases at fancy prices; the process of inking being kept a secret, to ensure that they shall be sent back from time to time for re-inking; the type-writer meanwhile standing idle for several days. We are assured by the representative of a certain type-writer that not only is there no one in this country who understands how to ink a ribbon, but that there is only one individual in America who can do it properly. And our informant is his agent!

We propose to give a brief description of the various machines to which we have alluded, without attempting to give a complete list of the advantages of each, or weigh to their comparative merits.

The *Remington* is naturally the first that claims our attention, since it was practically the earliest in the field, and is the most generally known. Until competition arose a few years ago, it was only provided with capital letters, figures, and stops. The machine shown in fig. 1 has 41 keys, each of which prints two characters. The keys are arranged in four rows, and are supplemented by a spacing bar, running the whole length in front of the keys; and two changing keys, by which either the capitals or the small letters are thrown into action. The keys are pivoted at the back of the machine, and attached to each is a pull-down wire, connected to a lever which hangs nearly vertically. These levers are arranged in an oval, and are so proportioned that when a key is struck the lever to which it is attached is thrown upwards. The end of the lever carries the type, and each impression is made at the same spot. The upper part of the machine consists of a carriage provided with a rubber roller round which the paper passes. The carriage is moved one step to the left immediately after each impression has been made, or by a depression of the spacing bar. The movement is effected by a spring, which is wound up by the act of pushing the carriage back at the end of the line. The handle projecting downwards towards the keys serves both for pushing back the carriage, and, by pulling forwards, turns the roller, and moves the paper on for a fresh line. When the end of a line is approached, a bell rings at each depression of a key, warning the operator that there is room for only a few more letters, and that he must either stop at the end of the next word, or divide it, and use a hyphen. The difficulty of ending the lines evenly makes the right-hand margin of a type-written sheet more uneven than ordinary manuscript. In setting up type for ordinary printed matter, the compositor "justifies" each line, or brings the end of it to an even margin, by selecting spaces of different widths. This can be done after the type is arranged; but with a type-writer it is not until the last two or three letters that it can be seen how the line will end. Where a particularly neat copy is desired, the sheet may be copied again on the machine, using a rather longer line, to allow for a double space here and there. With the Remington typewriter, a sharp "staccato" is required, but not much force is needed. An improved pattern has just been brought out, having provision for a wider sheet of paper, together with other improvements which we have not had an opportunity of inspecting, as there was not one to be seen at the depot when we called for that purpose.

A very important advantage offered by the Remington over most other machines is one which is not due to any inventive skill; this is, that the agents have the means for effecting repairs, and can supply broken or worn-out parts, and have skilled men to send out to put their machines in order, while most other typewriters labour under the disadvantage which was so much felt when sewing machines were first introduced, viz., that no repairs could be made without sending to America for the new parts; and then there was the risk of some improvement having superseded the very part which had proved defective. It is to be regretted that large numbers of type-writers have been sold in this country before they had been properly worked out. Defects were said to be due to the want of skill of the operator, when they were really faults of construction in the machines. The agents having a few more in stock, and being quite unable to effect repairs, frequently had to take them back again.

The agents for the Remington are alive to the fact that a type-writer is not of much use without paper, though, as with other machines, we are assured that "its appearance is ornamental, and it is a beautiful piece of furniture for any library." They have accordingly made arrangements for providing suitable material for writing on, though any type-writer will write fairly well on almost any ordinary paper. It is, however, of great importance for producing manifold copies that the proper kind of paper be used. Six or eight copies can be produced at the same time by placing carbon paper between the sheets. Ordinary thin post paper and common carbon paper are quite useless for the purpose. The agents of other type-writers are following this example, and it would be well if they would also be as ready to admit defects in the machines they sell, and to execute repairs themselves, instead of asserting that an accident is so rare that they do not find this to be necessary.

The *Caligraph* may be noticed next, since it professes to be an improved Remington, and resembles the older machine closely, at first sight. The levers are made of sheet steel, like the ribs of an umbrella, and the joints are provided with adjusting screws to take up the wear. The levers in the earlier forms of Remington were liable to get loose, and the levers being long compared with the length of their pivots, wrote an uneven line. A polygonal roller is provided, so that the type may strike against a flat, instead of a round surface. There are no less than seventy-two keys, each of which prints one character; they are placed on a level, instead of in steps. *(To be continued.)*

INTERNATIONAL CONGRESS OF METEOROLOGISTS.—The French Meteorological Society has announced its intention of holding or trying to hold an International Congress of Meteorologists by the inopportunity of the Paris Exhibition of 1889.

Natural History.

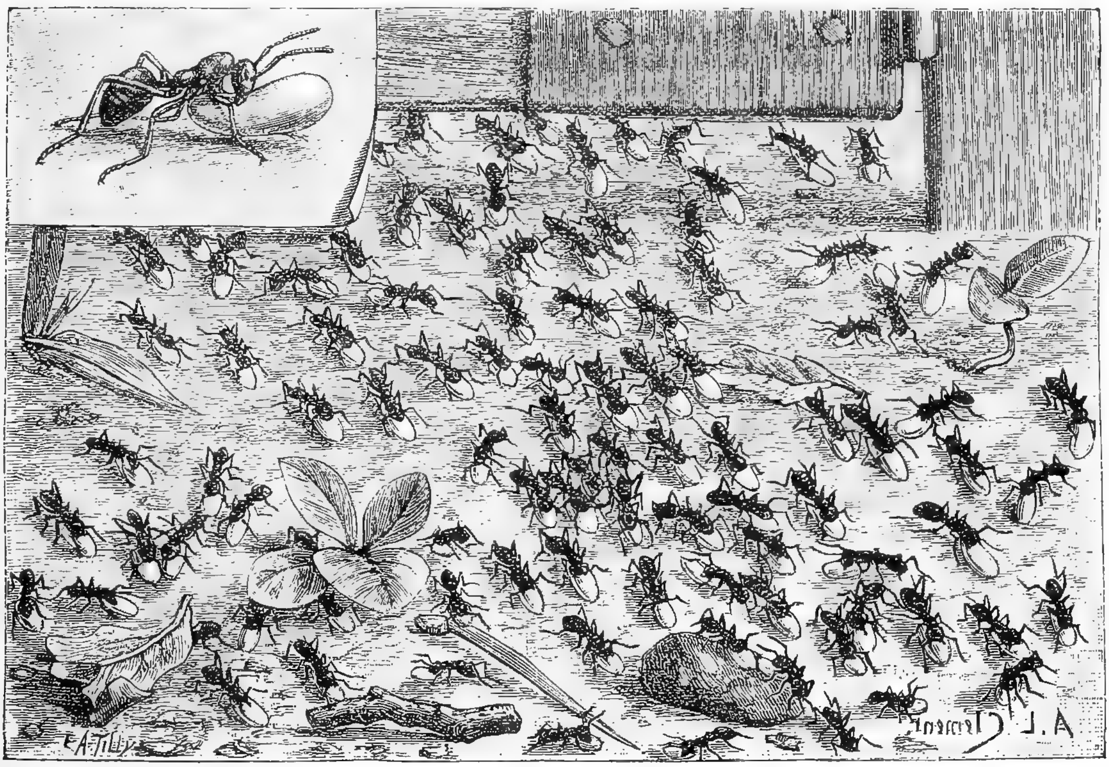
ON THE MANNERS OF ANTS.

M. G. A. Hirn, the well-known physicist, gives in *La Nature* an account of a slave-hunt among ants, which will, perhaps, not be thought less interesting from the absence of certain technicalities which a biological specialist would have introduced. He writes :—

On Saturday, July 14th, 1888, in very bright sunshine, I was walking along a road passing from south to north, running, at the place where I was, along the walls of a garden. I soon observed at my left hand, by the wall, a legion of brown ants, of a large size, marching rapidly and in good order all in one direction. The column, rather more than an inch in breadth, was more than five yards in length. It set out from a plot of ground rather higher than the road, covered with grass and weeds. It descended by a bare path having an incline of more than 45 degrees. At the end of this track it turned abruptly at right angles to follow the main road. I quickened my steps, and reached the head of the column, which was distinctly limited, and I followed attentively to see what might be the object of this expedition, which was clearly the execution of some well-conceived plan.

I had already noticed that during the march of this army several ants, seeming to have changed their minds, returned towards the rear, traversing all the ranks. But I saw that after communicating with some one of their comrades whom they seemed to be seeking, they resumed their onward journey. On arriving at the gate of the garden the head of the column halted, and all the rest, as they came up, arranged themselves in a circle of considerable diameter. It was evident that they were holding a council of war, and concerting measures to be taken. Soon the circle opened, and the ants began to pass under the gate, no longer in a serried column, but spread out over a large space, and marching more slowly and with circumspection. I saw them moving towards a plot of grass, where they were lost to view.

That day I felt unwell, and I walked on sadly, thinking of what I had just seen. Here was, I thought, an unfortunate nation, exiled from its homes, and in search of a more propitious abode. This was all a mistake. What I had just witnessed was an expedition for the purpose of plunder. On returning by the same road about half an hour later, I saw the brown ants coming home in triumph, each grasping in its jaws the pupa (commonly, but erroneously, called eggs) of some other species. They no longer marched in order. Each ran on independently, keeping a firm hold of its prey, as it may be seen in the figure.



Was this merely a prey which they were with a barbarous refinement of taste seeking for their diet? Or were not rather the pupæ intended to be reared so as to become slaves? Was this an odious act of rapine which I had just witnessed, or do the ants thus deprived of their freedom submit willingly to their lot, as to a predestinate career? In any case the defence, if defence there had been, cannot have been energetic; no one pursued the victors, and none of them appeared to be wounded.

The first part of the drama had saddened me, though I had misinterpreted the facts. The end was still more painful. Yet I consoled myself with the reflection that slave-holding ants, if they are no more righteous than their human imitators, understood better their own true interests. They do not maltreat their victims too much.

The species of ants whose pupæ are thus carried off continue to exist, so that they are not deprived of all their brood.

Since the epoch when Descartes, by an unhappy inspiration of his genius, tried to reduce (lower) animals to machines, and when his fanatical disciple Malebranche carried this theme to extravagance, since the day when Buffon, in contradiction with his pompous tirades on the dog and the horse (the echoes of which still haunt us), strove to prove that in the animal every thing is mere instinct and mechanism, a considerable advance has been made in this order of questions. Just as no astronomer now contests the plurality of worlds, no naturalist denies the manifestations—often very exalted—of intelligence, reasoning, and other psychic faculties, not in the animal kingdom taken in the lump, but in certain species, and in certain individuals of such species. Man being considered—of course by himself—as the highest type of animated nature, we might be led to think that those lower species which in certain respects are comparable are those which approach him nearest in their structure. If this is, generally speaking, the case, we find exceptions the most enigmatical. How widely does our organisation differ from that of an ant, and yet in the scene just described we recognise actions where instinct falls into the background, actions which presuppose consecutive observations, reasoning, and communication between individuals which no one would suspect *à priori*.

The two ant-hills which I have described—that of the plunderers and that of the plundered—are remote from each other, and the latter is in an enclosure. Instinct might tell the large brown ants that there exist other ants capable of doing work which themselves are unwilling or unable to perform. But here the revelations of instinct would stop. To satisfy their demand it is evident that the idle or incapable ants must have scouts ranging in search of a nest of industrial ants and penetrating boldly into it (?) to see when the pupæ are fit for transportation, and then returning home to inform their companions that the time is come. This information must be rapidly communicated to the whole society, and the marching orders must be perfectly understood since the head of the column advances quickly and in good order. The legion must have guides quite sure of their object and of the road to be taken. The ants which turned back and traversed all the ranks to see if all was in order, knew doubtless that in their species, just as it is the case among mankind, intelligence and the sense of duty are not alike in all individuals. The council of war held before the attack is the proof of intelligent foresight. No empty head in command had said, "Everything is ready."

Why I have enlarged on this subject is because I had never previously seen among these tiny beings a sequence of varied acts all combined, leading the observer to the same conclusion. To recognise in the scene which I had witnessed merely mechanism and instinct, I must have been myself a mere automaton.

Pisciculture.—All attempts made to acclimatise the true salmon (*Salmo salar*) in the rivers of Southern France, Italy, and other countries of the Mediterranean basin have failed, as the waters are too warm for the fish at the season when they ascend the rivers in order to spawn. The Society of Acclimatation of France has therefore undertaken to introduce the salmon of the Sacramento (*Salmo quinnat*). No fewer than one hundred thousand ova of this species have therefore been brought over from America in the steamer *La Bourgogne*, and have been placed for incubation in the tanks of the piscicultural laboratory of Quillan. As soon as the young fish have reached a sufficient degree of maturity, they will be set at liberty in the river Aube. It is hoped that the climate of the Mediterranean basin will be sufficiently like that of the Sacramento to allow of their multiplication.

Abstracts of Papers, Lectures, etc.

PHYSICAL SOCIETY.

At the meeting held on December 8th, 1888, Professor Reinold, F.R.S., President, in the chair, the following communications were read: Note on a Modification of the Ordinary Method of Determining Electro-magnetic Capacity, by Mr. J. W. W. Waghorne, D.Sc. In determining capacity absolutely from the throw of a galvanometer, and a steady deflection through a known resistance produced by the same battery, error may arise from the imperfect elasticity of the fibre (when short), and the resistances required are often greater than can be conveniently obtained. The latter difficulty may be overcome by taking a known fraction of the potential difference used for charging the condenser to produce the steady deflection, and the former error may be reduced by observing the first swing due to the permanent current, instead of the steady deflection produced by that current. By adopting this latter device, the logarithmic decrement need not be determined, and the time required to make a measurement is considerably reduced.

Dr. Thompson pointed out that error frequently arises from the capacity of the key being appreciable where small condensers are being used, but the author stated that the modification was not intended for such cases.

Professor Ayrton remembered having used, in conjunction with Professor Perry, the throw due to the permanent current instead of the steady deflection, when experimenting with condensers containing E. M. F.'s, and believed they abandoned it on account of the difference in decrement on closed and open circuits.

Mr. Sumpner regarded galvanometers with small differences in damping on closed and open circuits, as unsuitable for ballistic purposes, and mentioned a case in which the latter was only half the former.

Mr. Boys considered the damping would be modified by having the condenser joined to the galvanometer terminals, and thought the decrement should be decidedly different from that on pure open circuit.

In thanking the author for his paper, the President said that any improved arrangements of well-known experiments or of lecture apparatus, would always be gladly received, and reminded members that in bringing such before the Society they would be carrying out one of the chief objects for which it was founded.

"On Some Facts connected with the Systems of Scientific Units of Measurement," by Mr. T. H. Blakesley, M.A. The author considers that the C. G. S., and Practical (Quadrant, Volt, Second), system of units do not satisfy the requirements of a perfect system in which the chief ends to be kept in view are:—(1)

Correlation, (2) *Simplicity*, (3) *Comprehensiveness*, (4) *Naturalness*, and (5) *Convenience*.

In a properly *Correlated system* all the quantities considered should be so connected by the equations representing the laws of nature, that no co-efficients are required in expressing any unit in terms of others, for *Simplicity*, quantities essentially the same should be measured by the same units, and to be *Comprehensive*, the system should embrace all the physical ideas which occur; to be *Natural* its units should be closely or decimally connected with natural units, and for *Convenience*, they should agree with established (though arbitrary) units, either actually or decimally. In the two systems referred to, correlation has been more completely realised than any of the others, but simplicity is by no means satisfactory, and the want of comprehensiveness was discussed by Professor Rucker at the last meeting. The "second" is unnatural in not being a decimal subdivision of the solar day, and the gramme is derived from the centimetre by assuming the density of water to be unity, whilst the inconvenience arising from the relation between the horse-power and the watt or the erg, is universally acknowledged.

Two general formulæ are given in this paper for converting magnitudes expressed in Practical, and C. G. S. electro-magnetic measure into C. G. S. Electrostatic units.

Though the formulæ may be found useful, the author thinks it would be far better to adopt one system for all measurements, and suggests a "Coalition System," in which v is taken as the unit velocity. If in this system the "second" be retained, then the unit of length will be 30 earth-quadrants, and if the quadrant be taken (as in the present practical system) as the unit of length, then the unit of time will be $\frac{1}{30}$ sec. The influence of such changes on present standards is then discussed, and the relation between the new unit of power and the horse-power found to be unsatisfactory.

To endeavour to bring the horse-power and the unit of power into decimal relation, the author expresses the physical quantities in terms of length, time, and power, from a table of which it is evident, what units will be affected by changing the unit of power, and tables of converting factors are given when the latter unit is taken as ·746 watt or as 7·46 watts.

A summary is given towards the end of the paper in which the union of the two electrical systems by choosing $\frac{1}{30}$ sec. as the unit of time is recommended, the effect of which is to make the unit of capacity $\frac{1}{900}$ Farad., and that of resistance 30 ohms. Before concluding, the author deprecates the practice of giving specific names to particular units, for by so doing subsequent necessary changes are made much more difficult.

Dr. S. P. Thompson thanked the author for his prefix, *megisto*, denoting multiply $\times 10^{12}$. Referring to the choice of air as the standard for specific heat, he remarked that convenient coincidences were not always to be trusted, and that the specific heat of air depended on the pressure to which it was subjected.

Some Improved Polarising Apparatus for microscopes were exhibited and described by Dr. S. P. Thompson. For polariser, he uses an Ahrens prism, and for analyser a flat-ended one of his own design. The Ahrens prism is formed from a rectangular block of spar, two faces of which are perpendicular to the optic axis; two cuts parallel to the axis are made from the middle of one side to the ends of the opposite, and the cut faces are polished and cemented by Canada balsam. A short prism with wide angle is thus obtained which can be readily fitted to the substage of the microscope. The analyser, which consists of two wedges of spar, is mounted in a tube which fits on the eyepiece, and by recognizing that the upper end need not be larger than the pupil of the eye, the author has been able to considerably reduce the length of the prism, and still keep the bottom end large enough to collect all the rays passing through the eye piece.

Several ingenious methods of cutting spar so as to produce prisms with minimum waste, were described and illustrated by models, and a "nicol" made by the inventor at the age of seventy-nine was exhibited.

Mr. Lant Carpenter asked the author why he condemned analysers placed directly behind the objective, for in his experience this arrangement gave the most satisfactory results.

In replying, Dr. Thompson said his experience was decidedly different from that of Mr. Lant Carpenter, and mentioned that Zeiss had abandoned the common arrangement and now introduced his analysers between the two lenses of his Huyghenian eye-pieces.

ZOOLOGICAL SOCIETY.

At the meeting held on December 4th, Professor Flower, C.B., LL.D., F.R.S., President, in the chair, Mr. Oldfield Thomas, F.Z.S., gave an account of the Mammals obtained by Mr. C. M. Woodford during his second expedition to the Solomon Islands. The author stated that the total number of species of mammals known from the Solomons was brought up by the present collection from thirteen to twenty-two, and that of these no less than eight had been discovered by Mr. Woodford, his previous collection having contained examples of two and the present of six new species There were also two new genera of bats to be added to the one previously described. Mr. F. E. Beddard read a paper upon the genus *Clitellio*, which had been recently investigated by him at the Marine Biological Station at Plymouth. The paper contained an account of the anatomy of two species, *Clitellio arenarius* and *C. ater*; the most important fact referred to was the presence of an oviduct, which had only lately been found in the Tubificidæ (in the genus *Psammoryctis*). The paper also contained some remarks upon the synonymy of the two species, particularly of *C. ater*, which was probably identical with d'Udekem's *Tubifex benedii* and with Zeuger's *Peloryctis inquilina*. It was also pointed out that *C. ater* is not congeneric with *C. arenarius*, but probably belongs to Eisen's genus *Hemitubifex*. Professor Howes and Mr. Davies read a paper on the distribution and morphology of the supernumerary phalanges in the Anurous Batrachians. The authors described for the first time the primary mode of development of a supernumery phalanx. They concluded that the same is in the Anura identical with the interphalangeal syndesmoses, and that the syndesmoses and phalanges are derivatives of a common blastema. In its fully differentiated condition the structure in question was shown to be functional in receiving the direct thrust under the weight of the falling body in saltation; all the variations in structure being readily intelligible on that view.

The authors discussed the bearings of the facts upon classification and upon the broader question of the morphology of supernumerary phalanges in general. They showed that the facts of development indicated a probable intercalary origin of the latter from the interarticular syndesmoses; and that the numerical increase of the phalanges in the Cetacea may have been associated with the loss of ungues, somewhat similarly to the way in which the muliplication of segments of the cartilaginous rays in the paired fins of the Batoidei would appear to have been connected with the disappearance of horny fin-rays.

The authors also showed that the Discoglossidæ alone among the Anura retained for life the undifferentiated syndesmoses, and that this feature testified more forcibly than anything else to their low affinities. They also described a community of structure between the modified syndesmoses in certain Anura and the apparatus of the knee-joint in Mammals, and urged that the facts were such as to necessitate a reconsideration of the morphological value of the latter. A communication was read from Mr. J. J. Lister, F.Z.S., giving a general account of the natural history of Chrismas Island, in the Indian Ocean, which he had visited 1887 as naturalist to H.M. surveying-vessel *Egeria*. Mr. Lister gave a detailed account of the birds obtained in Christmas Island. Of these, seven were land birds, all of which belonged to species peculiar to the island, though some of them approach their allies in the Indian Archipelago very closely. Mr. Oldfield Thomas, F.Z.S., read a paper on the Mammals of Christmas Island, obtained by Mr. Lister during the same expedition.

This was followed by reports on the Reptiles of Christmas Island obtained during the expedition, by Mr. G. Boulenger, F.Z.S.; on the Terrestrial Mollusks, by Mr. Edgar A. Smith, F.Z.S.; on the Coleoptera, by Mr. C. J. Gahan; on the Lepidoptera, by Mr. A. G. Butler, F.Z.S.; on the other Insects, by Mr. Kirby; and on the Annelida, Myriapoda, and Land-Crustacea, by Mr. R. I. Pocock.

ROYAL HORTICULTURAL SOCIETY.

At the last meeting of the Scientific Committee specimens of oak wood, forwarded by Mr. Burbidge, which had been used for spokes of wheels, but found to be remarkably brittle, and consequently useless, were submitted to Professor H. Marshall Ward for examination and report. The following communication was received from him: "I have cut numerous sections of the pieces of oak, and have made a very thorough examination of the wood, but must say I can find no traces of fungi or pronounced decomposition. Nevertheless, the tracheides of the wood seem to be abnormally short, and have occasionally granular 'deposits' in them—also in the medullary ray cells—which I should like to know more about. I cannot explain the matter, but should be glad of further specimens for examination."

Mr. Henslow submitted some specimens of abnormal ivy blossoms to a microscopical examination, which were exhibited at the last meeting by Dr. Masters, together with drawings by Mr. G. W. Smith. The dried condition of the flowers precluded a very exact determination of the abnormality, but there appeared to him to be little doubt but that stamens replaced the carpels. The sepals, petals, and stamens were normal, but above the superior disc—which is normally formed by the upper and exposed part of the carpels—were a crown of supernumerary anthers. The vascular cords which normally represent the dorsal ribs of the carpels bore the anthers. In the centre was a depression in lieu of the ovary cells, and apparently some minute and rudimentary anthers occupying their place. These seemed to be due to staminody of the placental cords, which normally occupy the centre of the inferior ovary.

Professor Church gave an account of an analysis of the tubers of the new vegetable *Stachys tuberifera* which he had himself made, and by which he confirmed those of Dr. A. v. Planta, recorded in *Landwirthschaftliche Versuchstationen*, Nos. 5 and 6, 1888. It appears that they contain 78 per cent. of water, 1·5 per cent. of albuminoids, 1·7 per cent. of non-albuminoids or amides, 16·6 per cent. of sugars, ·7 per cent. of fibre, ·1 per cent. of ash, ·2 per cent. of fat, and a trace only of starch. Comparing this analysis with that of potatoes, it appears that the water is in larger quantity, it being 75 per cent. in them; the flesh-forming albuminoids are rather more than in potatoes, while the sugars replace the starch, of which there is some 15 per cent. in the average analysis of the potatoe.

Mr. O'Brien exhibited palmate tubers of some South African species of *Satyrium*, which showed two years' growth, having been plunged in moss only; the tubers, instead of developing a leafy axis, had formed fresh tubers only, the stem and leaves being produced in miniature, being about half an inch in height. Mr. Wilson mentioned the fact that lilies sometimes behave in the same way, and that the process was identical with "supertuberation" in potatoes, in which case the "eyes" gave rise to fresh tubers instead of stems, when situated too deep and with too much heat, according to the experience of Mr. Boscawen. Mr. O'Brien remarked that the importance of the knowledge of the above phenomena lay in the fact that it was often supposed that tubers and bulbs were lost or decayed, from the non-appearance of the flowering stems, while they might still be present in the soil, but were for two or three years simply reproducing bulbs at the expense of the old one, without flowering at all.

Mr. G. Swailes forwarded a young live tree grown from a layer, the only one of 500 which exhibited peculiar contorted boughs. A graft taken from it in the spring exhibits the same peculiarity. Dr. Hogg remarked that it appeared to resemble the "contorted" variety of the hawthorn. The curving and twisting were apparent even in many of the minutest twigs. It was thought by some to be due to mischief or injury by insects, but the above facts seem to point to other causes. It was referred to Chiswick, to be grown, to prove the constancy of the feature or otherwise.

Mr. T. Christy, of 25, Lime Street, sent a new production for antiseptic bandages called *Christia*. It is constructed of thin whity-brown paper, expressly made of Manilla hemp (*Musa textilis*), which consists purely of remarkably long liber-fibres, which doubtless tend to give it greater tenacity. It is then subjected to a process with glycerine, olive oil, and other substances, which render it translucent, with the appearance of oiled silk. It subsequently is treated with salicylic acid, carbolic acid, or other disinfectant, and rendered antiseptic. Its advantages are great tenacity, extreme lightness, being not more than one-third of the weight of oiled silk or gutta-percha sheeting, antiseptic, and perfectly impervious to moisture. It was thought that it would prove so exceedingly useful in horticulture, *e.g.*, for binding up budding, sending specimens by post when the exclusion of air is essential, while strips would be serviceable for tying plants to stakes, etc.

Mr. Henslow showed specimens of Korsambi nuts, received from Mr. Christy, of the seeds of *Schleichera trijuga*, of the order *Sapindaceæ*. It was supposed to be the source of Macassar oil, but this was strongly doubted. Mr. Morris observed that it is called the "Indian oak-tree," and is abundant in India and Ceylon, and is valuable for its timber.

A specimen of *Juniperus occidentalis* (Hook), collected in Eastern Oregon, U.S.A., by Mr. William Stewart, was forwarded by him from Greenock, N.B. It was first found by Douglass in the Story Islands, in the Columbia River. It was also found in the Klamet Mountains, in the Oregon territory, at 5,000 feet. It grows from 40-80 feet high, and like other species, varies in foliage in passing from the young to the older stages. The specimen sent was spiny-leaved, or in the characteristic condition of the young stage. It is remarkable for the strong and disagreeable odour when bruised (Gordon's "Pinetum," p. 163).

Mr. Henslow called attention to the fact that the year 1889, besides being the centenary of the chrysanthemum in Europe, was also that of the dahlia in England. It was introduced by the Marchioness of Bute in 1789, and figured with single and double forms in *Bot. Mag.*, vol. xliv., t. 1885, and *Bot. Reg.*, vol. i., t. 55.

ROYAL METEOROLOGICAL SOCIETY.

At the first meeting of this Society for the present session, held on the 21st November, Dr. W. Marcet, F.R.S. President, in the chair, the following papers were read :—

"Results of an Investigation of the Phenomena of English Thunderstorms during the years 1857-59," by Mr. G. J. Symons, F.R.S. This paper was written nearly thirty years ago. It has now been communicated to the Society at the request of the Thunderstorm Committee. The paper contains a summary, chiefly in statistical form, of some of the results of an investigation into English thunderstorms and the accidents produced by lightning during the years 1857-59. The author found that in sheet lightning the most prevalent colour is white, then yellow, blue, and red. In forked lightning the order is nearly reversed, blue being more than twice as frequent as any other colour; then red, white, and most rarely yellow. Sheet lightning was seen about twice as often as forked.

"Notes on the Meeting of the International Meteorological Committee at Zurich in September, 1888," by Mr. R. H. Scott, F.R.S. The Committee recommended certain rules for the publication of data by travellers, etc., so as to ensure their being useful for the advancement of sound climatological knowledge. The proposals for an international cloud nomenclature, as recommended by Mr. Abercromby and Professor Hildebrandsson, did not commend themselves to the Committee, who suggested that the subject should be further studied. At the conclusion of the meeting the Committee was dissolved.

"On a Method of Photographing Cirrus Clouds," by Dr. A. Riggenbach. The author exhibited some photographs of cirrus and other fine clouds which had been obtained by using the surface of a lake as a polarising mirror.

Mr. A. C. Stratten exhibited some models of very large hailstones-spheres about 2½ inches in diameter, which fell at Montereau, about forty miles south-east of Paris, on August 15th, 1888.

BRISTOL NATURALISTS' SOCIETY.

At the meeting held on December 6th, the Rev. T. Hincks, F.R.S., being in the chair,

Dr. Burder exhibited specimens of a rare fungus, *Spæria polymorpha*, found in his garden, and Professor Leipner commented upon the life history of this, and an allied species, *S. concentrica*, which grows on some old ash trees near the Westbury Road.

Mr. C. J. Trusted then read a paper on the common mole and its habits. After giving a brief description of its structure, he said that their favourite breeding-places were woods, and that the large mole-hills they make their nests in are usually well hidden in briers and brushwood. Usually there are five young ones in each nest, which is lined with dry leaves, and never with dried grass or moss. Many galleries and passages run round and to the nest. In some parishes there used to be a regular annual charge for a mole-catcher, but the old custom has died out. That there was some need for the custom Mr. Trusted explained by telling of a disastrous flood caused by moles piercing and undermining a river wall put up to keep the river Wye from overflowing. Moles require some depth of soil, and hence are never found on the Downs, though Mr. Trusted has found two colonies of the meadow-mouse. He said that though weasels were sometimes caught in mole-traps, it was very doubtful if they preyed on moles. One very interesting point about moles is that they have a great intuitive knowledge of changes in the weather, being very active just before a hard frost or the beginning of a thaw. This may be due to their food being near the surface at these times. He said that in some fields near a large wood in which moles did a great deal of damage he shot nine in one winter's day. Moles do a great deal of damage to grass land, and also to corn crops, by raising the young wheat or barley when it has just sprouted. Mr. Trusted then mentioned the interesting fact that there are no moles in Ireland, though very few authors mention the fact. The mole is probably a long-lived animal. Its chief enemy is man. Its structure and fur are particularly adapted to its underground life. It is an extremely voracious animal, as the following will show: A mole was captured while trying to make its way into the hard frozen ground, and put into its captor's pocket. Soon afterwards a field-mouse was caught, and put in with the mole. Very soon afterwards there was a considerable disturbance, and when the narrator returned home he found that the mole had eaten the whole of the mouse except the head.

Mr. Charles Jecks then read a paper entitled "Suggestions as to Causes of the Difference in Colour between the Flowers and Foliage of Tropical and of Temperate Regions." He first said that it was certain that tropical flowers and foliage are not so brilliant as those of more temperate climes; the opposite opinion being due to our seeing tropical plants under exceptional conditions in greenhouses, and also plants collected from many regions grouped together. Mr. Jecks then suggested that the disparity of colour might be due to the great richness of the soil and the large amount of moisture in a tropical forest, for with a bright sun and dry, poor soil we find the flowers more brilliant, and he said that in our own climate the same was true, a richer soil and a moist atmosphere deepening the colours of the flowers; and further, in a dry season and with plenty of sunshine the colours of the flowers were more brilliant. With respect to some mountain flora, which seem an exception to this, he suggested that they might be remnants of more tropical ones. He said that the greater number of brilliantly coloured scentless flowers in our climate might be accounted for by the visits of butterflies, etc, a variation towards increased brightness inducing more frequent visits from insects, and hence the plant has a greater chance of setting its seeds and propagating the species; and hence, by the law of heredity, the variation in the colouring matter is passed on and rendered permanent, and even increased in amount. He gave, as an instance, the flowers of East Norfolk, where the soil is dry and light; they are distinctly brighter than the same wild flowers in Northamptonshire, where the soil is heavier and the air more moist. Foliage, Mr. Jecks said, is, as a rule, much deeper in colour in the tropics than in the temperate zones, the only exception being the foliage of the trees in New Zealand. The condition in a tropical forest, namely, the comparative absence of light, and the warm, damp atmosphere, would tend to produce a deep foliage, whereas the cool, dry atmosphere of more northern regions would produce a lighter hue.

DUNDEE NATURALISTS' SOCIETY.

At the meeting held on December 5th, Mr. James Durham, F.G.S., President of the Society, read the concluding paper of a series which he has given at intervals on "The Geology of Dundee and District." On this occasion Mr. Durham dealt specially with the geological period known as the post-glacial. He explained that towards the end of that great time of cold—the glacial period—the land sank into the sea until it stood at a level more than 100 feet lower than it does at present. In the course of this subsidence floods of water from the melting glaciers swept vast quantities of the *débris* of moraines from the land into the sea, where it accumulated to a great thickness round the shores, so that when in course of time the land rose again a vast terrace of sand and stones was found spreading all over the low-lying country. The remains of this terrace now form a striking feature in the landscape of the seaward parts of Fife and Forfar, and, indeed, all round the Scottish coast. If we desired to picture to ourselves the Dundee district during the formation of this 100 feet terrace, we must imagine all the ancient burgh of Dundee under the sea, whose water would stand, roughly speaking, two-thirds the height of the Old Steeple, and consequently well up the Constitution Road and Hilltown slopes. All the flat lands between Dundee and Perth and the valley of the Earn would be far under the water level. The Howe of Fife and nearly all the land between Dundee and Arbroath would be submerged. Indeed, a large part of Scotland would be cut up into groups of islands, round which rolled the waves of a sad and melancholy sea, in which icebergs floated. It would be a dreary and miserable land, into which no man or animal cared to come, which was perhaps the simplest reason for the absence of the remains of living creatures in the remains of the sea bottom represented by the 100 feet terrace. Mr. Durham went on to describe how the action of denudation removed the greater part of this terrace, especially when the larger rivers ploughed their way through it, while the wave of the sea materially aided in its destruction. As the land rose, standing much higher than now, the action of various denuding agencies formed upon the remains of the terrace an earthy soil suitable for vegetation. The climate having become mild and temperate, a luxuriant growth soon covered the ground, and great forests spread over the valleys far up into the high lands, and out over parts of the present bed of the North Sea. Remains of this forest bed are still found at many parts of the Firth of Tay, and Mr. Durham exhibited a collection of roots, twigs, leaves, and nuts found at the Stannergate. After a period of unknown duration the land was again depressed to the extent of 40 or 50 feet, and the sea swept over the low-lying forest parts. Simultaneous with this the climate became colder, and probably in the Highland glens glaciers again formed, as the Tay and Earn were at the same time laden with extremely fine material likely to be derived from the grinding action of glaciers on the rocks of their valleys. This fine clay, with sand and gravel, covered the submerged forests, and formed what are now called the carse lands of our Scottish firths. At length the land again rose steadily until it stood 25 to 30 feet lower than at present, resting at this level for a very long time, and a great and most important beach was now formed, for on the terrace which is now represented by this beach nearly all our seaport towns are built. Indeed, as the lecturer pointed out, the fact that it forms such a convenient means of approach to the ocean makes it not improbable that the maritime supremacy of the British Islands is greatly owing to the existence of this beach. After this the land again rose until it reached its present level, at which point it has probably stood for many thousands of years. Mr. Durham, in the course of his paper, pointed out the localities which helped to bear out the story of the geological history of Dundee and neighbourhood.

BOURNEMOUTH SOCIETY OF NATURAL SCIENCE.

At a meeting held on Nov. 30th, the Rev. G. H. West in the chair, a paper was read by Dr. Hyla Greves upon "The Hand; its Mechanism in Man and Brute." The lecturer said, to prevent misconception, he would first define the term "Hand," which was intended to include not only the human hand and that of the quadrumana (or four-handed animals), but all modifications of the fore limb of the vertebrata. We may, he continued, here enumerate the various uses which the hand and arm serve in the animal kingdom. In its simplest form, as in fishes and birds, for example, it is used almost entirely for the purpose of locomotion in water and air respectively; in man, on the other hand, its use in locomotion is practically nil (its use in swimming excepted), but it is as a prehensile instrument and organ of touch that it finds its chief use. Again, in the monkey tribe and the sloths it serves for both the purposes of locomotion and apprehension, and to a less extent the same may be said of the carnivora, *e.g.*, the lion and cat, which use the paw firstly as a means of locomotion, and secondly as a prehensile organ in procuring prey; while in the ungulata, or hoofed animals, it is solely used as an organ of locomotion. In comparing the structure of the human hand with that of other animals we recognise the bones which form the upper extremity or arm of man in the fin of the whale, the wing of the bat, the paddle of the turtle, and the wing of the bird. We see the same bones perfectly suited to their purposes in the paw of the lion and the bear, and equally fitted for motion in the foot of the horse and camel, and adjusted for climbing or digging in the long-clawed foot of the sloth or bear. It is obvious, then, that we have to consider the human hand only as presenting the most perfect combination of parts, and exhibiting the bones and muscles, which in different animals are suited to particular purposes, so combined as to perform actions the most minute and complicated, consistently with powerful exertion. During an explanation of the bones and mechanism of the arm and hand, the lecturer showed, with regard to the elbow joint, a mere bending and straightening was all that was necessary for purposes of simple locomotion, but that in those animals who use the hand for other purposes—as for digging or burrowing—it was necessary they should be able to rotate the hand, and therefore the two bones of the forearm are so constructed that they can partially roll over each other, giving rise to the movements of pronation and supernation of the hand. It might be imagined that the easy motion of the hand resulted from the structure of the hand itself; but on the contrary, the movements which appear to belong to it are divided amongst the bones of the whole extremity. The power of opposing the thumb to any of the other fingers is the chief characteristic of the hand of man. Without the thumb the power of the fingers would avail nothing, and accordingly the large ball formed by the muscles at its base is the distinguishing characteristic of the hand of an expert workman. As we progress downwards through the animal kingdom, in every instance where the fingers become rudimentary the thumb is the first withdrawn. In the quadrumana, which comprises apes and monkeys, the thumb may be entirely wanting, but when present it is more or less opposed to the other digits, but to a less extent than in man. In the bats we find a very curious modification of the hand and arm to form a kind of wing, all the digits, with the exception of the thumb, being exceptionally elongated, these elongated fingers being united by an expanded membrane, which also extends between the fore and hind limbs and the side of the body. This membrane serves for flight. In the horse and other hoofed animals the leg is used solely for locomotion, and modified accordingly. The characteristic feature in the foot is that portion of the toe which touches the ground being always encased in a hoof, or greatly expanded nail. Dr. Greves took the fore leg of a horse as a typical illustration of the hand adapted purely to the purpose of locomotion, and by diagrams explained how the fore limb was constructed to withstand shock, and beautifully adapted for strength and elasticity. Taking the lower part of the leg, the wrist was shown to occupy the middle of the leg, and to constitute what is improperly called the knee. Below this point is a most radical change in the arrangement of the bones as compared with the hand of man: no resemblance at first sight seems to exist between them. Dr. Greves carefully traced the connection in structure between the hand of horse and man, showing them to be composed of the same elements, modified to suit in each case their special uses.

The lecturer, after describing the hand of the various orders of animals, and explaining the special adaptation in each case to the special use, made a few remarks on the hand as an instrument of expression.

Society of Chemical Industry (Edinburgh Board).—On December 5th a paper on "Natural and Artificial Foods for Farm Stock" was read by Professor Ivison Macadam. These foods, the lecturer said, might be divided into the substances on the farm itself, and those bought in by the farmer. He first discussed the chemical and feeding properties of the grasses, cereals, and roots classed under the first heading, and gave some details as to the comparative feeding values of hay obtained and grown in various counties in Scotland and England, as well as from America, Canada, Germany, Switzerland, and Algeria. Large quantities of hay, he said, were annually shipped by the latter country to Leith and other Scottish ports, and found a ready sale for the winter feeding of sheep, etc. The process of making ensilage was described, and the chemical properties explained, as well as the changes which plants undergo when being made into ensilage. The process was specially recommended in hill districts or in very wet seasons, the principal drawback being the cost of the necessary erections. Reference was then made to a series of letters published during last summer, in which the writer urged that the cereal crops in such very backward seasons should be made into hay, and eaten in that form either before or after being thrashed out from the grain. Afterwards, the various seed cakes were considered, and the method of manufacture explained, also the substances with which they were adulterated or mixed, and the paper was brought to a close by the valuation of cakes for feeding and manurial purposes. Specimens of the various substances mentioned in the paper were on exhibition in the hall. Afterwards a paper entitled "Note on Filter Stands" was read by Mr. D. B. Dott, F.R.S.E., giving a description of a stand to ensure the stability of filters while persons were working with chemicals; and a paper was also read by Dr. L. Dobbin, "On the Detection and Estimation of Caustic Alkali in Presence of Alkaline Carbonates," which was stated to be a test based on a new version of Nessler's test for ammonia.

Liverpool Geological Association.—This association held a conversazione on December 3rd, which was opened by the President, Mr. A. Norman Tate, F.I.C., by a short address. He afterwards referred to the exhibits of the evening, and some of their special features. Amongst these exhibits were microscopes and slides, shown by the President and others, illustrating micropetrology, etc., also a large number of specimens in connection with mineralogical science, these latter being under the special charge of Mr. D. Clague, F.G.S., and included a new goniometer and other novel instruments now used in research, and illustrations of their uses were given by Mr. Clague during the evening. Some excellent photographs of Tarawera (New Zealand), kindly forwarded by Professor Judd, F.G.S., were shown, and Mr. Joseph Lomas, A.N.S.S., gave a short address on the same district. There were also exhibited specimens and diagrams of Arran pitchstone, and syenite, showing metamorphism, and Maus rock specimens from Castletown Bay by Mr. J. Hornell, and diagrams showing glacial action in the same neighbourhood by the Secretary, Mr. J. E. George; sections across the London basin by Mr. Joseph Lomas; crushed and weathered boulders from the boulder clay of this district, by Dr. Ricketts, F.G.S.; a model of the quarry at Oxton, showing interesting geological features, by Mr. H. C. Beasley; collection of coral by Mr. R. Wilson. There were also shown by Mr. T. R. Connell, Vice-President, a a fine work on fossil saurians, by Prof. Owen, and there were many specimens and prize drawings by geological students.

FLINTS.*

PROFESSOR JUDD, in asking those present to study with him the subject of flints, said it had been his special aim to illustrate the methods in which a scientific inquiry should be conducted. The object of science was to study the phenomena of nature with a view to discovering the causes by which these phenomena were produced. Now, the legitimate method of doing this, as he had pointed out to them already, was, first, to collect as many facts as possible bearing upon the subject, and secondly, to arrange these facts so as to illustrate the subject under consideration; thirdly, to frame a theory, it might be a tentative theory, that should harmonise with all these facts; and fourthly, to try the theory, when it had been framed, by the whole of the facts that could be discovered, and if it was verified, to accept it; but if the theory were not verified, to reject it. Now, many people seemed to think that this was a very cumbrous and round-about way of proceeding, and that there was a short and easier method by which the desired results might be obtained. The method might be shorter, but he thought a little consideration would show them that it was neither sounder nor so satisfactory as the scientific method. The method which these people would employ was, "First make your theory, then look out for facts which seem to support the theory, and most carefully shut your eyes to all such facts as do not fit the theory." Now that might be characterised as the unscientific method.

He did not know how it was—perhaps it was due to the fantastic forms and curious appearances which these flints often presented—but from some cause or another flints seemed to exercise a wonderful fascination for a speculative mind, and they would not be surprised, therefore, that the attempts to settle the question of the origin of flints by a short and easy method were by no means few in number. For example, there was a very worthy and gallant colonel who used to reside on the Wiltshire Downs, and as the hills around were covered with chalk-flints, he thought he ought to know all about these chalk-flints, and that he must tell the world all about them, especially the way they were formed, and he wrote a book called the "Old Chalk Cemetery," in which he clearly proved, to his own satisfaction, that the flints had been brought by the general deluge, and mixed up in the chalk, and that it was obvious these flints were remains of once living things, the forms of which he could easily recognise. More than this, he gave a great deal of trouble —unnecessary trouble he (the lecturer) was afraid—to the curators of museums, for he was continually getting friends to put questions in Parliament why museums were filled with the class of objects they contained, whereas there were more interesting objects with which he undertook to fill not only those museums, but as many museums as the nation liked to build. He never gained his object in getting flints into museums, but what the museums would have been like they might judge from the book, which contained a number of remarkable photographs. Turning over the pages of that book, he found the echinus eating into the back of the bird of paradise. Now, considering the habits of the bird of paradise and of the echinus, it must have been only during the general deluge that they could have been brought together. Of course, he had the unicorn and the sea-serpent—that goes without saying; and as for noses, and arms of men, women, and children, he had sufficient to stock any number of museums. To take another example, there was an equally worthy old clergyman, who had written a book, which bore the title of "The Chalk and Flint Formation; its Origin in Harmony with the Ancient and Scientific Modern Theory of the World." At all events, they would have no difficulty in guessing that the "scientific modern theory" was no other than the author's own. His work was illustrated by photographs of big flints. Then he went on to insist that all chalk flints were nothing but meteorites that had tumbled down in the chalk mud, and somehow or another had got laid into bands. He (the lecturer) must not follow these amusing flights of imaginations; there was no end to them. As Lyell used to say, "When the human imagination is untrammelled by those awkward things, facts, it revels with all the freedom characteristic of motion in vacuo."

Now, let them come down from those wonderful flights, and, curbing their imagination, look at the facts which could be obtained by the use of experiments and observations, and see what they could find out concerning the origin of flints. If they were puzzled at any point they would confess it; but they would try, nevertheless, to find out what were the theories which the study of flints would lead them to form. He thought he could best do that by inviting them to consider, first, what were the sources of the silica, which, as they had now learned, formed flints; secondly, what was the way in which that silica was separated to make flints; thirdly, let them ask what was the way in which the silica of flints reached its present position, so that it occurred in nodules and bands in the chalk; and fourthly, what were the changes which it subsequently underwent so as to present the forms that they had seen it did at the present time. First of all let them ask what were the sources of the silica which formed flints. Now they would remember an experiment he tried in the earliest lecture in which he took a substance which was a compound of silica and one of the alkalies, potash or soda, formed by melting those two substances together —it would dissolve in water. They would recollect that to that solution of this compound of silica and one of the alkalies he added a little acid, and the result was that the compound was decomposed, the alkali and the acid remaining dissolved in the water, and the silica remaining also dissolved in the water; and he showed them how, by a method of dialysis, could be separated from the acid all the alkali left in the water. Now, that was the operation which was continually going on in the earth around us. Everywhere that experiment was being continued on a small scale. All those rocks which were formed by the action of fire, which were called igneous rocks—all those rocks contained silicates of the alkalies. It was a compound of potash or soda and silica, and wherever water was percolating through rocks they found small quantities of this substance—silica combined with one of the alkalies—passing into solution; and if the water contained an acid, however weak it might be, then this decomposition of the silicate was going on, and silica was passing into a state of solution. It was true that this action went on very slowly indeed, like many of the processes in nature, and that it would take many years in a large mass of rock to produce as much silica in a dissolved state as he produced in the course of a few seconds by the experiments he performed. But

* Fifth Lecture to Working Men at the Royal School of Mines.

nevertheless the process was continually going on, and silica, by that series of actions which had been demonstrated by actual experiments, was passing continually into a state of solution. That slow and gradual action, in contradiction to the sudden and brutal mode of treating things which was characteristic of our chemical laboratories, was very characteristic of the operation of nature. The result of that action was that all natural waters contained silica in solution. As they had seen, the waters of those hot springs, the geysers, contained an enormous proportion of silica in solution—which was rapidly deposited, but all these natural waters of the globe, and the waters of rivers and lakes, as well as of springs, the waters of the ocean—all these natural waters contained silica in solution, but in very minute proportions. Indeed, the proportions were so minute that it almost defied the art of the most careful chemist to determine what the proportion was. For example, he had a number of analyses of different rocks, and the quantity of silica in many of them was very minute; but if they had an analysis of natural waters the quantity of silica present in each of them would have to be represented by he did not know how many noughts following the decimal point, and then followed by some small figure. The experiments on the waters of the ocean had shown that the quantity of silica in the ocean was always less than one in 50,000, and in most cases less than one in 100,000, and in some cases much less than that; so they saw the natural waters, whether they were the waters of springs, or of rivers, or of lakes, or of the ocean, contained silica in solution; yet they contained almost inconceivably small proportions of silica; and the question might arise, how could that almost inconceivably small proportion ever become separated from the enormous quantity of water in which it was dissolved? Of course they might take large quantities of this water and boil it down, thereby turning the water into steam, in which case all the dissolved matters, including the silica, would be left at the bottom. But that was not an operation that went on commonly in nature. The ocean was not boiled down periodically, or even the lakes, in order to get out the silica; but there was an agency at work, a very important agency indeed, by which this silica was concentrated and separated from the water of the ocean, from the waters of lakes, from the waters of rivers, of springs even, and the water flowing over the surface of the earth, when it fell as rain, silica was taken up in all these cases, and it was concentrated from this water, separated from this water by the wonderful agency to which he had already called their attention. As he had already pointed out to them, there were remarkable organisms which took water into their organisation with their food, and in the process of breathing which went on in marine animals. Those waters were taken into their organisation, and the silica was separated from the water, minute as it was in proportion; it was separted in the solid form, and formed the skeleton, or the hard part, of these organisms. They would recollect that he pointed out to them that there were three classes of organisms which had that wonderful power of separating silica from its state of solution. The first of these organisms were the excessively minute ones, the plants known as the diatomacæ, or, for short, diatoms; and he would bring before them those diatoms as showing them the wonderful forms assumed by their skeletons. They were exquisite little objects, each consisting of two valves, like portions of pill-boxes, one fitting inside the other, but so excessively minute that many of them could be only just seen even by the highest powers of the microscope, and in many cases they were covered with the most exquisitely beautiful ornamentation, as shown in some figures he exhibited, which were only a few selected out of many, many thousands of known forms. These skeletons were composed entirely of colloidal silica which had been separated from its state of solution in water. Then there was a class of minute animals that lived both in marine and fresh water, and in water which was a mixture of both, and some of them inhabited fresh water, and all the forms that lived under these different conditions were very distinct. The radiolarians only lived in the sea. They were strictly marine forms. These radiolarians were so minute that many of them hardly reached the size of a pin's head, but they were gigantic compared with diatoms. The radiolarians assumed an enormous variety of forms. (A small selection of forms were exhibited.) 4,000 forms were described as being found by the *Challenger* Expedition, and Dr. Haeckel admitted that he was far from having described the whole of them. There was still a third class of organisations, the *silicospongia*, siliceous sponges, which had skeletons which were as much larger than the radiolarians as the radiolarians were larger than the diatoms, and some of the forms of the rods building up the skeletons of the siliceous sponges were shown. Now, these organisms were all very minute—the diatoms excessively minute—but, nevertheless, they made up in numbers what they wanted in size; and as they had already seen, there was at the bottom of the ocean extensive deposits of white, sticky mud, some of which were entirely made up of diatoms, and these were called the diatomaceous oozes, and others were made up of radiolarians, and these white muds were called the radiolarious oozes; and although they did not find mud made up entirely of sponge-spicules, there were many that were largely made up of them. But besides that, they found among the rocks of the globe many deposits, made up of these organisations, consisted chemically of silica and nothing but silica, which formed those materials known as tripoli and diatomite. These were made up of the skeletons of these diatoms. If they took the minutest fragment, they got hundreds and thousands of these marine creatures sprouting together. They could be examined under a microscope, and a wonderful variety of forms could be seen; hundreds and thousands of forms might be detected in one of these deposits. So again, in other parts of the earth they found rocks made up of radiolarians. In the Island of Barbadoes there was a rock covering many miles of country, and of considerable thickness, entirely made up of these radiolarians; and in other places, again, they might find beds of siliceous rock, as Dr. Hinde so well showed, which, when examined by a microscope, were seen to be made up of sponge-spicules. The part played by those organisms seemed to be in inverse ratio to their size. The deposits were greater as the things were smaller. They did not find great rock-masses made up of bones of elephants, but they did find them made up of microscopical foraminifera. The most important deposits were made up of the smallest organisms, the diatoms; the next important were made up of the radiolarians; and comparatively thin and unimportant deposits, though not insignificant, were made up of siliceous sponges. This was Nature's way of effecting most astounding results by means of the smallest and most insignificant agencies.

What they had seen of the microscopical structure and character of flint would convince them that though flints consisted entirely of silica, they were nevertheless not deposits made up of radiolarians and sponges, or of diatoms. Now let them consider if it was possible that the materials which had been collected to form these organisms could be by any process collected so as to form these nodules and bands which were found in the chalk, and which were called flints. He had also called their attention to the way in which those nodules and bands occurred in the chalk; he had also pointed out to them a series of chemical analyses which showed that when there existed chalk without any flints they found silica distributed through the mass, but that chalk with flints did not contain silica distributed through it, and the suspicion was at once aroused that by some process or other the silica which formed the organisms deposited with calcareous materials which formed the chalk mud; that this silica had been separated by some means and collected into these nodules. Now let them see if there were any grounds for believing that such takes place. He had already pointed out how readily colloidal silica passed into a state of solution, and he had also brought before them evidence that this dissolved silica was everywhere present in different kinds of rocks. They would recollect that he showed them how old limestone rocks, when dissolved, were found to contain little crystals of quartz, which must have been formed from silica distributed in a state of solution through those rocks, or, rather, in solution in water, that percolated through those rocks. In the same way he had shown them how sand-grains, which were broken fragments of quartz crystals, were continually being formed into perfect quartz-crystals by the deposition upon them of silica, which had been also in a state of solution. He had shown them, too, that, when flints got broken, they became cemented together again. If they tested that with acid they would find the cement was siliceous cement. It was silica, which had been deposited to repair the flint; so that they readily saw that the colloidal silica forming these siliceous organisms in a mud such as that which gave rise to the chalk might easily pass into solution; and he showed them a case where, in globigerina-ooze, the silica forming these organisms had clearly passed into a state of solution and been deposited in a fresh form.

Now, he must recall to their mind the facts to which he pointed with regard to silicification. They would recall the case of a plant he brought before them—there was no mistake about it being a plant originally. He put before them a section showing all the cells and vessels having their different forms, and the whole was perfectly silicified. Particle by particle the carbon and the other elements present in the wood had been dissolved away, and each molecule of the complex organic compound had been removed, and the molecules of silica had been put in its place, so that the whole structure had been built up just as a red brick building would be restored if one knocked out a red brick and put in a white, and did this with every brick in succession until the whole of the original red brick building had been removed and the white brick, having exactly the same form and characteristics of the red brick building, pnt in its place. This was what went on on a finer scale in nature when a substance was undergoing silicification. The original structure, particle by particle, was removed, and a fresh particle of silica was put in its place until in the end there was scarcely a vestige of the old substance. There was nothing but silica, but this silica presented all the forms that were found in the original mass of wood, or whatever it was that was silicified. He must ask them to bear in mind how completely this process of silicification took place.

The result of the study of all those microscopic sections to which he called their attention the other day, was to show that flint was silicified chalk mud. Chalk mud consisted essentially of the substance calcic carbonate, or carbonate of lime, but this calcic carbonate of the chalk mud can be silicified particle by particle. The carbonate of lime might be dissolved and silica put in its place, and the whole mass become a mass of silica. This chalk mud was sometimes found perfectly silicified and formed into flints. Every particle of each of these rounded shells is dissolved and particles of silica put into its place, so that but for the fact that it does not dissolve in acids they might at first sight think they were dealing with actual chalk, but they were dealing not with actual chalk but with silicified chalk—a piece of chalk which had undergone precisely the same change as the silicified wood had undergone. Now it was very true that all flints that were examined did not look like chalk mud. There were many flints in which evidently a very great change had taken place, and the way in which that change had taken place he must proceed to show them, but from these changed flints to those which were manifestly nothing but chalk mud, there was every possible graduation. They found some flints which if put side by side with a piece of chalk, and in thin section, appeared so much alike that they would say there was no difference between them, yet the one was chalk and the other was flint. There could be no doubt that silicification had taken place because these were all forms of shells which were contained in carbonate of lime. There were no siliceous shells like these. It was clear that these shells had been originally carbonate of lime, and had been converted into silica by this wonderful process of replacement and silicification. Now, he must ask them to accept the fact, which was the result of an enormous number of observations of different specimens, that from the flint which was most obviously and clearly nothing but silicified chalk mud, they had every possible gradation in the flints that showed none of this structure. He must just call their attention for a moment to some of the curious phenomena seen during the silicification of the chalk mud.

He had already pointed out to them how curious were the results that arose from heteromorphism — the same forms which the same substance silica could assume. We have two totally different substances or different properties of the most startling character, and both consisted of silica. There were other substances besides those two which were especially important—the crystalline silica known as quartz, and colloidal silica. Now, just as silica existed in two different states with different properties, so calcic carbonate or carbonate of lime, which formed chalk mud, existed in two forms. There was the crystalline form, known as the mineral calcite, and there were the less stable forms known as aragonite. He wanted them to recognise that there was a form which was stable, and which was not liable to change, and which was not easily passed into solution, and there was another that easily changed and passed into solution. They saw the effect of that in many fossils which they found in flints. These fossils were sea urchins, very much like in structure some of the sea urchins living at the present day—sea-eggs some people called them—but really different in species. Now in these cases the original sea urchin was completely filled with flint, and it was so completely filled that the holes through which the arms of the animal passed, stood out as little needles on the surface, but the shell itself was not represented. The shell itself was represented by a hollow space; the outside of the shell had left its markings on the flint. There was what was called an external cast, and where the original shell was there was an empty space. The reason of that was that the shells of these animals were composed of this comparatively stable substance, calcite, but all round was the unstable chalk-mud. Now this chalk mud most easily passed into solution, and was therefore silicified. The calcite of the shell being more stable resisted this process and therefore remained as carbonate of lime. Occasionally they might find flints with shell remaining as carbonate of lime, but in other cases it would be found that water had percolated through the mass, after the silicification of the other part had been completed and had dissolved out of the calcite, leaving a hollow space. There was in the case on the table one of the most curious burrowing sponges. This sponge had burrowed into the shell, and the result had been that the hollows had been filled by that chalk mud, and wherever those hollows existed, silicification had taken place; but in the shell around the cell, silicification had been resisted, and afterwards the shell had been dissolved away, and thus they had got the curious appearance that was presented. There was no end to the number of very interesting features which they might find exhibited in shells fossilised in flint, and he hoped that the facts they had been considering would enable them to interpret them.

He must confess that although it was perfectly clear that flints were silicified mud, and that silicification had taken place by the series of processes he had described—he must confess that there was a problem still unsolved—why did silica concentrate itself along certain bands, and form certain nodules? That problem was still an unsolved problem. There were several old experiments which were tried many years ago, but which were unfortunately not confirmed. They must not rush too hastily to the conclusion that the author of these experiments made a mistake. He took a material like chalk mud through which he distributed a small quantity of dissolved silica—matter containing silica in solution. He then put a number of minute bodies consisting of silica, bodies like sponge spicules, in the hope that these would serve as centres of aggregation—that where these siliceous bodies were, the silica would tend to collect in masses analogous to chalk flint. Probably, as it seemed to be an experiment which was not yet fully confirmed, they must admit that there was still a problem remaining unsolved with regard to these shell flints.

Now, he must call their attention to the fact that many flints did not exhibit the characters of silicified chalk mud, and in order to explain the reason of this he must recall their attention to the doctrine of allomorphism—a doctrine that substances having the same composition might have their molecules so arranged as to form a substance with totally different properties. A most remarkable example of this was frequently pointed out to them in the case of silica. Silica existed in two forms. Colloidal silica, which was unstable and easily passed into solution, was unstable because it was constantly tending to pass over into the other form, crystalline silica; and crystalline silica, or quartz, which was stable—almost insoluble. There was a constant tendency for this unstable colloidal silica to pass into the stable form known as quartz. Perhaps he could illustrate these paramorphic changes by an experiment with a substance he had with him, which like silica had a great tendency to pass into another state; this substance was mercuric iodide. If they examined a little of that material under a microscope, they would find it consisted of red crystals of very definite shape, but he could make it assume a different form of crystal which had a bright yellow colour, and make it pass into the allomorphic form, though the composition of the material did not change. One of the ways in which it might be made to assume the allomorphic form was by heating it. They saw by the simple action of heat the red substance had passed into its allomorphic yellow form. Now the red substance was a stable form, and the yellow substance was the unstable form. The stable answered to crystalline quartz, and the unstable to colloidal silica. The yellow was a particularly unstable substance, and mechanical pressure would cause it to change. He would take a hard substance, and they would see that wherever the hard substance had touched those yellow crystals, they had instantly broken up and arranged themselves in the forms of new crystals which had a bright red colour. Although there were not many cases which by a change of colour this paramorphic change was manifest, such paramorphic changes were continually going on. If he left the paper with which he had been experimenting for three or four days, he would find the whole of the yellow material had gone over to the red material—that paramorphic change had taken place spontaneously, so unstable was the yellow material that he had produced. Now in the same way the colloidal silica which was deposited in sponge spicules was constantly tending to pass over into crystalline silica or quartz. When they examined any of the rocks which were made up of sponge spicules, with a microscope, they constantly found the sponge spicules re-arranging themselves in crystalline form. The first change which took place when masses of chalk mud were silicified was that colloidal silica gradually passed particle by particle into minute crystals, forming bodies known as microlites. These microlites built up structures which were of great beauty, and which were at once recognised by the fact that they polarised light when examined between cross angles; instead of having a dark body, they polarised in wonderfully brilliant colours. The white flint which was found in the centre of chalk flints, and on the outside of chalk flints—this white flint was formed by the silicification of the white chalk mud, and, like the white chalk mud, it was white, and it retained its colour, although a greater or smaller proportion of the siliceous replacement might pass into a crystallised form by this paramorphic change. But when this white flint has this colloidal silica added to it, the change produced was exactly like that change which was produced when a piece of blotting paper was put into water, or still better into oil. In that case opaque blotting paper became translucent, and when they dried it again it became opaque. The introduction of this colloidal silica between particles of silicified white chalk might make it assume a grey tint, and pass from the opaque to the translucent condition. On the other hand, on the outside of flints the action was continually going on. Percolating water was eating out the colloidal silica, which filled up the interspaces between the silicified particles, and then the mass became white, in just the same way as a piece of white blotting paper becomes white and opaque on the water being driven out of it, and on its being held before a fire. Such were the changes which went on in the mass of silicified chalk mud constituting flints, and that so far as had yet been made out was the process of flint-making. Now, he must call their attention to another process that was going on in nature—the destruction of flints. At first sight flints seemed the most indestructible of bodies. The flint instruments he would have to point out in the next lecture seemed to be the most imperishable of objects. Objects made of iron, bronze, gold, and silver even, got lost and perished, but articles chipped out of flint remained apparently unchanged even from very remote periods; but although, speaking in the historical sense, flints were very indestructible, geologically, when dealing with not thousands but millions of years, flints were extremely perishable, and the reason of that was that they consisted in part of this unstable substance, colloidal silica. Quartz, on the other hand—perfectly crystalline quartz—was almost the most imperishable of substances. It had no tendency to change its state. It was in its stable condition, and it only passed into solution with the greatest difficulty, so that grains of sand which built up the sandstone and quartzite and other rocks, were many of them of inconceivable antiquity. Many little grains of sand could be proved to have been washed out of one formation and gone into another, and to have been washed out of that and gone into another, and the process repeated again and again, perhaps a little being worn from the outside of the sand grain on each occasion, but nevertheless the quartz grain retained its identity. Now flints were continually rubbing against one another, and being worn down, first into sub-angular flints, and then at last into perfectly rounded flints or pebbles, and it might seem that they ought to find among the rocks of the globe large quantities of little fragments broken off the flints, and when, as at Blackheath and many other places about London, they found beds wholly made up of rounded flint-pebbles, they might well expect the sand in which they were embedded to be made up of flint-particles. But they would find it was not sand composed of flint, but sand composed of little bits of quartz. He would see if he could make them understand why that was. First he must call their attention to the fact that if they wanted to dissolve a thing quickly they must reduce it to powder. The reason of that was very obvious. The action of the acid could only take place in a solid substance at the surface where the two met together. The consequence was when they had a mass with an increased surface, the action between the acid and the substance took place immediately, and solution was very rapidly effected. That was the way in which they always proceeded in chemical laboratories; if they wanted to proceed quickly they pounded the mass up. They reduced it to powder so as to increase the surface. Nature did not chose to reduce flints to powder, but did the thing in a slightly different way. They would remember what he said the other day about the conchoidal fracture of flint, and they would recollect those beautiful specimens which he put before them abstracted from a church which he did not chose to mention, the surfaces exhibiting the taps that fell from the old mason's hammer; the hand was dead long ago, but the force of the blow, and the weight of each particular blow, could be calculated to a nicety from the way the cracks had been produced in these flints. They were like the negative of a photograph, quite invisible when first struck, but they had been revealed by the weathering process going on in nature, and told their tale. Nature was continually doing things of that kind in ordinary flints. Here were some flints taken up on the shore during his summer vacation. It was one of the sorrows of geologists that they could never let their trade alone; it followed them everywhere—even to their holiday excursions to the seaside—and these flints, when the surfaces were examined, seemed to be covered with most beautiful curved cracks. If the flint was of fine grain, the fracture would be a fine one; if of course grain, a course one. If they picked up flints on the shore, they would find that a wonderful change had gone on—that along the line of cracks there had been a process of change. White flint had been developed along both sides of the crack, and the reason of that was that solvent action had penetrated along those cracks, eaten out the soluble silica on each side, and rendered the flint on both sides white and opaque. If they made a microscopic section of the flint, they could see how that process was going on. The white flint became opaque, the black clear and translucent, and they would see how this whitening of flint by solution of colloid silica between the particles was going on. In that way the whole mass of the flint was gradually broken up. The crystalline parts came off in the mud, and in time the whole flint was destroyed. If they took any specimens of those instruments which had been fashioned out of flint, they saw the beginning of the change. The original black flint was covered with a skin of a light colour. The process went on much more rapidly wherever the flints were rattling against one another on the sea shore. Wherever that process was going on they knew that nature was doing her work of making fresh fractures, producing new surfaces by which the solvent action of the water could operate on the flint. He had brought that fact before them, because it was a very characteristic way in which nature did her work.

CORRESPONDENCE.

The Editor does not hold himself responsible for opinions expressed by his correspondents, nor can he take notice of anonymous communications. All letters must be accompanied by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

THE SPARROW AGAIN.

Having noticed in your valuable paper a short controversy on the sparrow, I beg to add a few remarks concerning its behaviour to other birds. It has latterly been observed to seize upon the nests of the bank-swallow or sand-martin just as it does upon that of the common martin. Whether this is a novel habit or an old one, which has previously escaped observation, I am unable to say.

Sparrows habitually monopolise crumbs thrown out in the winter for the relief of starving birds. Being always in the majority, they attack and drive away the robin.

SANDY.

RECENT INVENTIONS.

The following list has been compiled especially for the SCIENTIFIC NEWS *by Messrs.* W. P. THOMPSON *and* BOULT, *Patent Agents of* 234, *High Holborn, London, W.C.; Newcastle Chambers, Angel Row, Nottingham; Ducie Buildings, Bank Street, Manchester, and* 6, *Lord Street, Liverpool.*

EXPLOSIVE.—Mr. C. D. Abel has patented an explosive compound as a communication from H. Schoneweg. This explosive is cheap, effective, and explodes without flame, and is not hygroscopic. It is made by adding to a mixture of an explosive nitro-compound and oxalic acid a large proportion of potassium nitrate.

HUT.—Mr. J. C. H. Peacocke has patented a portable hut. It consists of a framework of wood strengthened by tension rods without obstructing the passage through the building, and having walls, flooring, and roof of roller shutter, which will serve as a covering for the parts of the building when taken apart for transport.

LOCKS.—Mr. H. Steinke has patented a safety-lock. The object is to dispense with the use of springs in safety-locks, and substituting therefor a number of locking plates which are actuated by one or two keys, so as to slide rectilinearly, or turn, or swivel on pivots, and provided with notches for the entry of the shackle hook.

WATER-COURSES.—Mr. A. Langues has patented a method of excavating or deepening water-courses. It consists in causing a vessel provided with blades projecting down beneath its bottom to travel up stream so as, by narrowing the section of the water way, to effect an increase of velocity of the water, and cause it to impinge upon the bottom, whereby the material of the latter will be dislodged and carried by the current out to deep water.

ROLLER-MILLS.—Mr. P. Tofel has patented a roller-mill. The invention relates to the driving-gear, and by the use of it the differential velocity of the grinding rollers can be increased at will, without necessitating the employment of rollers of unequal diameter. The invention consists in the employment of rope driving-gear working in grooved pulleys, and effecting a differential velocity of the grinding rollers; the ropes are made of any suitable material, mechanism being provided to take up the slack.

ELECTRIC RAILWAYS.—Mr. W. L. Madgen, a communication from E. Manville, has patented a method of supplying electric railways or tramways with electricity. The secondary lead is divided into sections, each arranged to supply the locomotive as it passes along it, and each of these sections is connected to the primary lead, which extends continuously the whole length necessary to supply the last of the secondary sections, this main lead including appliances, whereby the currents transmitted from it to the discontinuous sections are caused to be of moderate tension.

PROJECTILES.—Messrs. M. Von Foerster and C. Wolff have patented an explosive projectile. The shell is provided inside with a tube rigidly connected therewith and open at its forward end; the fuse is lodged within this tube in such position that its initiating cartridge is separated from the charge of the shell by the walls of the tube. The fuse is secured by a fastening adapted to give way when, upon the shell striking against its mark, the fuse is impelled forward within the shell, and a channel is provided into which the fuse can fly, so that the initiating cartridge, on exploding, will be in immediate contact with the charge.

WATER METERS.—Mr. J. C. Panwels has patented a water meter. It consists of a cast-iron box, divided in two parts and fastened together. Inside this is a wheel with a groove; this wheel is connected by arms to a central axis, the arms being provided at one end with fans. The wheel has a part cut out, and at each end is a pipe leading outside the case for inlet and outlet of the water. The central pivot is connected to registering mechanism, and the spaces between the fans can be made to hold any desired quantity. The water passes into the wheel, and by its pressure operates the fans, which drive the registering mechanism.

CHURCH ORGANS.—Mr. H. T. Newbigin has patented means for automatically regulating the wind supply to church organs blown by motive power. A rocking lever is employed, having a constant angle of oscillation, in which slides a bar having attached thereto the connecting rod which works the air feeder. This bar is so connected that as the air-receiver expands it moves the point of connection of the bar nearer the centre of oscillation, thus diminishing the travel of the air-feeder, and as the receiver contracts, the point of connection is moved farther from the centre of oscillation, thereby increasing the travel of the feeder, and consequently the air supply to the instrument.

SHIPS.—Mr. J. H. Milne has patented apparatus for steering, manœuvring, and propelling ships which may be used as a screw propeller or paddle, and may be fitted at the stern or side of a vessel. In a screw propeller two diametrically opposite blades are fixed to a box upon a shaft. These blades are connected by a spindle which is fitted to turn in the box about an axis at right angles to the shaft. Internal gear is applied to the shank of the blades, and by it the blades can be turned, when desired for steering, so as to cause them to act transversely when passing the highest or lowest point of their circular course, and edgeways when passing the opposite point, accordingly as the ship is required to deviate to starboard or to larboard.

GAS GOVERNORS.—Messrs. H. W. and A. F. Cole have patented a gas governor. In this governor the gas enters at an inlet and passes down a centre tube, through holes and underneath a float, the quantity of gas passing through the tube being greater than can pass through a regulating screw. The gas raises the float and closes a valve sufficiently to admit only the quantity of gas that can pass through the regulating screw. The gas pressure at the outlet side of the regulating screw and the upper side of the float is maintained equal by a free gas passage, and the weight of float and valve being properly adjusted, it follows that any increase of pressure must first act on the underside of the float, raising same and closing the valve in proportion to the increase, and as the pressure decreases the float falls and opens the valve in proportion, thus ensuring a regular and uniform flow of gas for use.

SELECTED BOOKS.

Astronomy with an Opera Glass. Popular Introduction to the Study of the Starry Heavens with the simplest of Optical Instruments. With maps and directions to facilitate the recognition of the constellations and the principal stars visible to the naked eye. By G. P. Serviss. London: Sampson and Son. Price 7s. 6d.

Industrial Education. (Education Library) By Sir P. Magnus. London: Kegan and Co. Price 6s.

A Text-Book of Elementary Metallurgy, for the use of Students. By A. H. Hiorns. London: Macmillan and Co. Price 4s.

A Sketch of the First Principles of Physiography. With Maps and numerous Illustrations. By J. Douglas. London: Chapman and Co. Price 3s. 6d.

The World's Inhabitants; or, Mankind, Animals, and Plants. Being a Popular Account of the Races and Nations of Mankind, Past and Present, and the Animals and Plants inhabiting the great Continents and Principal Islands. With about 900 Illustrations, representing all the Types of Mankind, their Home and their Public Life, together with many of the Principal Types of Animals and Plants. By G. T. Bettany. London: Ward and Lock. Price 7s. 6d.

Seas and Skies in many Latitudes; or, Wanderings in Search of Weather. Maps and Illustrations. By R. Abercromby. London: Stanford. Price 18s.

A Short History of Natural Science. Fourth edition. With Corrections and Additions. By Arabella B. Buckley. London: Stanford. Price 8s. 6d.

Electric Bells, and all about them. A Practical Book for Practical Men. With more than 100 Illustrations. By S. R. Bottone. London: Whittaker. Price 3s.

Elementary Commercial Geography. A Sketch of the Commodities and Countries of the World. By H. R. Mills, F.R.S.E., Lecturer on Commercial Geography in the Heriot Watt College, Edinburgh. London: C. J. Clay and Sons. Price 1s.

On the Senses, Instincts, and Intelligences of Animals. With Special Reference to Insects. By Sir John Lubbock, Bart., M.P. With 100 illustrations. London: Kegan Paul, Trench, and Co. Price 5s.

DIARY FOR NEXT WEEK.

Thursday, Dec. 27.—Royal Institution, Albemarle Street, at 3 p.m.—*Clouds and Cloudland*, by Professor Dewar, F.R.S.

Saturday, Dec. 29.—Royal Institution, Albemarle Street, at 3 p.m.—*Clouds and Cloudland*, by Professor Dewar, F.R.S.

SALES.

The Charge for Advertisements in this Column is Sixpence for the first sixteen words, and Sixpence for every succeeding eight words. Advertisements for this Column should be received by first post on Tuesday to insure insertion in the following number.

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METEOROLOGICAL RETURNS

For the ten weeks ending on Monday, Dec. 10th, 1888. Specially prepared for SCIENTIFIC NEWS from official reports.

	Mean Temperature.	Rainfall.	Duration of Sunshine.
Scotland, East	44·1 degs., being 3·3 degs. above average.	8·1 ins., being 0·8 ins. above average.	92 hrs., being 62 hrs. below average
England, N.E.	46·0 ,, ,, 2·3 ,, ,, ,,	4·8 ,, ,, 1·8 ,, below ,,	141 ,, ,, 2 ,, above ,,
England, East	45·7 ,, ,, 0·8 ,, ,, ,,	4·8 ,, ,, 1·4 ,, ,, ,,	173 ,, ,, 13 ,, ,, ,,
Midlands ...	45·6 ,, ,, 1·3 ,, ,, ,,	6·4 ,, ,, 0·3 ,, ,, ,,	155 ,, ,, 1 ,, below ,,
England, South	47·3 ,, ,, 1·5 ,, ,, ,,	7·0 ,, ,, 0·4 ,, above ,,	163 ,, ,, 3 ,, above ,,
Scotland, West	46·3 ,, ,, 2·4 ,, ,, ,,	13·5 ,, ,, 1·8 ,, ,, ,,	104 ,, ,, 39 ,, below ,,
England, N.W.	46·9 ,, ,, 1·1 ,, ,, ,,	8·7 ,, ,, 0·1 ,, below ,,	115 ,, ,, 13 ,, ,, ,,
England, S.W.	48·5 ,, ,, 1·3 ,, ,, ,,	11·3 ,, ,, 0·6 ,, above ,,	170 ,, ,, 7 ,, ,, ,,
Ireland, North	47·6 ,, ,, 2·1 ,, ,, ,,	8·0 ,, ,, 0·4 ,, below ,,	136 ,, ,, 26 ,, ,, ,,
Ireland, South	48·5 ,, ,, 1·9 ,, ,, ,,	10·2 ,, ,, 1·5 ,, above ,,	146 ,, ,, 33 ,, ,, ,,
The Kingdom...	46·6 ,, ,, 1·8 ,, ,, ,,	8·3 ,, ,, 0·1 ,, ,, ,,	140 ,, ,, 16 ,, ,, ,,

The above period is fairly representative of the autumn of 1888.

Scientific News

FOR GENERAL READERS.

Vol. II. DECEMBER 28, 1888. No. 26.

CONTENTS.

NOTICE.

We beg to announce that after this date the publication of Scientific News will be discontinued. A year's experience has shown that, though the number of readers has increased, the rate of increase has not been sufficient to justify the continuance of this journal. An honest endeavour has been made to give in untechnical language particulars of many of the interesting and instructive advances made by scientific workers; and if we may judge from the many expressions of approval that have reached us, the endeavour itself has been successful. But, unfortunately, there does not yet seem to be a public numerous enough to give adequate support to such a paper as ours; so we have no choice but to thank heartily the contributors, readers, and correspondents who have given us their kindly help, and to bid them a reluctant farewell.

Subscriptions in hand after this date will be returned.

SCIENTIFIC TABLE TALK.

By W. Mattieu Williams, F.R.A.S., F.C.S.

In Scientific News, November 30th, is a very interesting report of Mr. J. E. Bedford's inaugural address to the Leeds Geological Association on "Natural Gas." In the course of this, Mr. Bedford says, "The remarkable purity of this gas is another important feature in its favour, and for this reason it is especially valuable in puddling furnaces, where the iron is very likely to be deteriorated by sulphur, etc., from inferior fuel."

Mr. Bedford has abundant text-book authority in support of this usually accepted idea that the fuel used in puddling furnaces may supply sulphur to the iron it is melting, but he is wrong nevertheless. When I went to Sheffield early in 1868, I believed the same, and many other things concerning iron and steel that I had learned from the writings of high authorities on pure science, and from the customary routine of laboratory teaching, which were afterwards refuted by the unsophisticated teachings of black-faced puddlers and other workers.

On entering upon my duties as chemist to the Atlas works, where about 5,000 of such men are employed, I found that the coal supplied to the works came from various pits, and was visibly variable in quality, some of it being very "brassy" *i.e.*, containing sulphur in the usual form in which it exists in coal, viz., as golden-coloured scales and crystals of iron pyrites. With the customary self-righteousness of the man of science, I looked down with pity upon the ignorance of the people who should use such coal indiscriminately for all the purposes of the works, instead of obtaining analyses of each brand and assigning the sulphurous coal to the work of heating boilers, and using only the purest for the puddling and reheating furnaces. I communicated these ideas—mildly, of course—to Mr. Ellis, the managing partner, who at once perpetrated the daring heresy of affirming his belief that the sulphur of the coal used in puddling furnaces had no effect whatever on the iron; but he had no objection to my full investigation of the subject.

I accordingly set to work by first determining the sulphur in each brand of coal supplied to the works, then superintending the puddling of a few charges of given pig first with the purest coals, and second with the most impure. On analysing and mechanically testing the results, I was surprised to find no measurable difference. The sulphurous coal was very variable; there were veins of pyrites running through certain lumps and none visible in others. I accordingly made a second series of experiments by using as fuel selected lumps of the worst quality. Still no increase of sulphur in the finished iron.

I then obtained a supply of pyrites in lumps and mixed this with the fuel, first in moderate quantities, then increasing them up to the extravagant amount of 56lbs. in the fuel of one charge ($4\frac{1}{4}$ cwt. of pig iron). No mischief was done; the finished iron was neither better nor worse than average, whether tested by chemical analysis or by the usual mechanical tests.

The facts being known, the rationale is not difficult to work out. The sulphur comes over with the reverberated flame as sulphurous acid, and this only strikes the cinder, *i.e.*, the fusible silicates, that float on the surface of the melted iron. The conditions are quite different in the blast furnace, where the pyrites come in contact with the iron in the midst of reducing, instead of oxidising, surroundings.

The first evening meeting of the winter session Middlesex Natural History and Science Soc[illegible] opened by an address by the annual Pres[illegible] Flower, Director of the Natural History [illegible] the British Museum, the subject of the address being an account of the general arrangements of the Natural History Museum and the recent additions thereto. In the course of this very lucid exposition a subject was touched which must be interesting to all the readers of the SCIENTIFIC NEWS, viz., that of the much-vexed question of opening our national museums on Sunday *afternoons.* Readers should note the italics.

One of the objections commonly urged against this innovation—the only one that, in my opinion, deserves any serious consideration—is that it may throw Sunday work upon the museum officials. Prof. Flower disposed of this by telling us that at least three-fourths of the staff are in favour of opening on Sunday afternoons, and many are so enthusiastic that they say that they will come and take their turns at attendance even without remuneration. In the course of the conversation that followed, Mr. Lant Carpenter told us that his father, the late Dr. Carpenter, and other men eminent in science had offered their services gratuitiously as guardians, taking turns on Sunday afternoons.

This, however, is not necessary. What is demanded is the evolution of parliamentary common sense, in sufficient quantity to enable our legislators to understand that the contemplation of a magnificent panorama of creation is no outrage upon the very sensitive religious scruples of a nation that permits the public sale of unlimited quantities of intoxicating drink at the time in question.

In reference to the employment of the museum officials, the increase of labour is practically trivial. Some people—including members of Parliament—imagine tha all the staff of the museum is occupied in standing in the rooms with wands in their hands, and staring at visitors. Such people do not, probably cannot, understand that a great collection of tens of thousands of specimens requires general and detailed attention involving a vast amount of work, and that besides all this it is part of the duty of the museum officials to assist *bona fide* students who use the museum for purposes of specific research. Like all others who have done this, I can give personal testimony to the efficiency of such aid and the courtesy with which it is afforded. About two years ago some bones were found in the London Clay, at Harlesden, and given to me. I took them to the museum for purpose of identification, and Professor Flower himself took them to the skeletons of the animals to which they belonged, and by placing each bone by the side of the corresponding one of each skeleton enabled me to settle the question of their origin in spite of my lack of special skill in comparative anatomy. Collectors and students in every branch of natural history use the museum for the purpose of identifying their specimens, and much other work.

The mere guardians are chiefly policemen, some of whom are on duty every Sunday, whether the museum is opened or closed. The additional guardianship demanded by opening on Sunday afternoon need not afflict the consciences of even the most tenderly constituted and most demonstrative of Sabbatarians.

As Professor Flower said, the one or two members of the staff and the few attendants will not be expected to sweep and clean, nor to stuff birds, nor arrange tablets, nor write labels; they will only have to walk to their [illegible]es, walk about a little in the museum, and then walk [illegible]gain; and these being very few out of a large [illegible]r turns to do this on Sunday afternoons would [illegible] distant intervals.

TYPE-WRITERS.

(*Continued from p.* 650.)

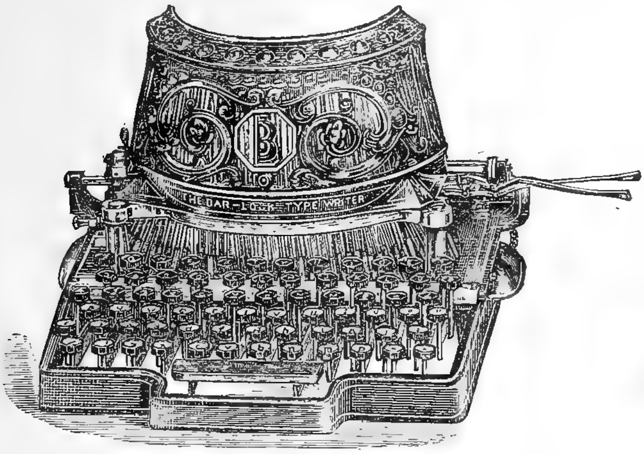
THE difficulty of "alignment," which is experienced in some type-writers, has been attacked by the *Barlock* The mechanical principle resembles that which we have described, but the arrangement of the parts is totally different. The keyboard is provided with seventy-two keys, one to each character, but the levers strike downwards. This has the great advantage of enabling the printed matter to be seen by the operator, up to within a few letters of the last one printed.

With the two machines already mentioned the whole paper carriage has to be lifted on a hinge in order to see what has been written. This is a matter of great importance to authors, or others who use the type-writer for producing their own compositions direct, since it is easy to fall into errors of tautology, if the last few words cannot be readily seen. The inking tape, which in other machines is gradually fed direct from one roller to another, passes round a wire guide, doubling back on itself, thus allowing all the writing to be seen but the last letter or two. In the only machines of this make which we have seen, this advantage is lessened by a bar which hides the whole of the last line. We understand that this is being altered in a new pattern.

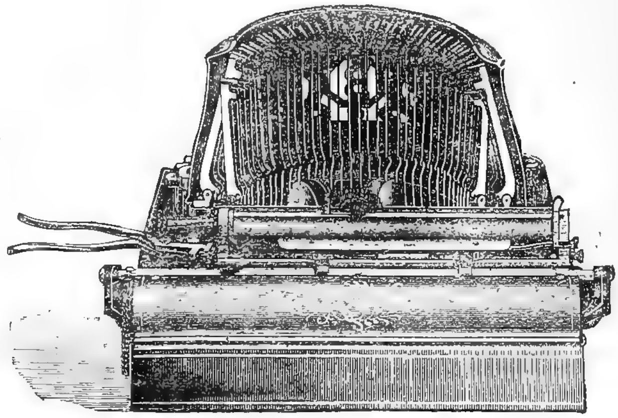
The feature from which the Barlock takes its name is the method by which the alignment of the characters is ensured, even if the levers become slightly bent or worn. A number of tapered pins project upward from a semi-circular plate which surrounds the point at which the type make their impressions. The type-bar, at the end of its stroke, falls between two of these pins, thus locking it, and ensuring that each letter shall fall exactly in the same place. The precautions which it is found necessary to take in the construction of such machines, to ensure their alignment, arise not only from wear of the pivots, but from the effects of an accident to which all machines of this class are liable, viz., the clashing of two type-levers if simultaneously depressed. This may occur either from carelessness, from writing at too high a speed, or from inexperience on the part of the operator. These machines are all heavy, and are suitable for use in offices, or for other purposes in which it is not necessary to move them about. They are generally mounted on iron stands, like sewing machines. The parts are numerous; repairs cannot easily be effected, even by a skilful workman; the type cannot be changed; and the price is about twenty guineas.

The *Hammond* type-writer occupies structurally, an intermediate position between the machines already mentioned and those in which the type are carried on a wheel or plate. This machine has a keyboard of only 30 keys, but they each control three characters, or 90 in all. The keys radiate from the centre, and are arranged in two rows. The curvature is a slight disadvantage, and might be easily altered to two sets, inclined to each other, thus V, one for each hand. The movement of the fingers in this instrument is more like playing on a piano than in other keyed type-writers, which are generally "pounced" upon with the first finger of each hand. Under ordinary circumstances, the keys print small letters and the four most common punctuation marks. On depressing a key marked "Cap." the capitals and four other punctuation marks are ready for work; and by the use of a key marked "Fig."

the figures, and no less than eleven other marks, such as £ % [*] and six fractions, can be employed. The type are arranged in three rows on two ebonite segments. Each of these resembles one-sixth part of a broad-tyred wheel, with the type set like three rows of nails around it. Each segment is attached to the centre by

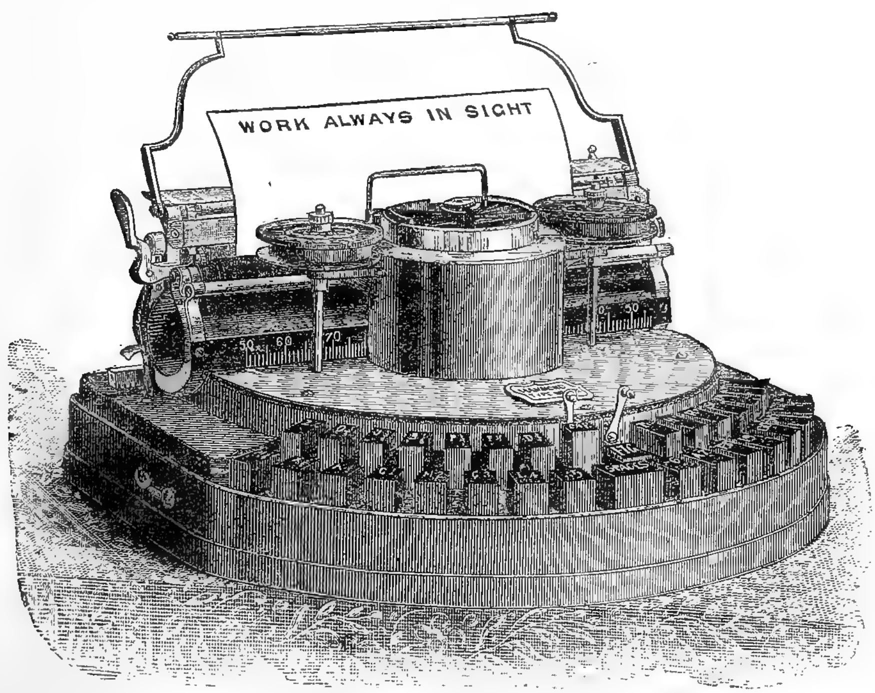


BARLOCK TYPE-WRITER: FRONT VIEW.



BARLOCK TYPE-WRITER: REAR VIEW.

five broad spokes. The segments lie wide apart when at rest, and the act of depressing a key moves one of them round, and at the same time raises a stop pin, against which it comes to rest, the proper type being then in position. Continuing the depression, a spacing



THE HAMMOND TYPE-WRITER.

hammer at the back of the machine is released, giving a blow which is quite independent of the force with which the key is depressed. The hammer is moved by the escapement action of the spring driving the carriage, which, as in most type-writers, is wound up by the act of pushing it back to commence a new line. It is impossible to damage the machine by depressing more than one key at a time. If several keys are depressed at once, the type segment stops at the stop pin raised by the key nearest the middle of the key-board, and the corresponding letter is printed.

The mechanism is most ingenious, and not only would it be impossible to describe it without drawings, but when seen in operation, is rather difficult to understand. The parts, however, are very strong, and require practically no oil. The alignment is perfect, since this merely depends on the level to which the type segments are raised by depressing the "Cap." or "Fig." keys. Another important advantage possessed by this machine is that the writing is visible up to the last two or three words, the paper rising up immediately in front of the operator. Even this might be improved to allow the writing up to within nine or ten letters to be seen, by a very slight alteration. The last word or two can be easily seen, if needed, by merely pushing the paper away from the inking tape. The method of giving the blow ensures that each impression is exactly of the same strength; but it cannot be made to "manifold" well, as the blow required needs so strong a tension of the spring that a considerable amount of friction is introduced. It has been asserted that the difficulty of stopping the type segments, dead at the right spot, and of overcoming the momentum and vibration, have been so completely overcome that it can be worked (we presume by some mechanical contrivance) "at the astonishing rate of from 400 to 500 characters per minute." The present writer has used a Hammond type-writer constantly for more than a year, and writes, when in a good light, at an average of 38 to 40 words per minute, and if pressed, can write 50 words against time. At the former speed, the letters situated at the outside ends of the keyboard often show signs of vibration, or that the type has rebounded. The appearance of the work produced by this machine is excellent. This is due to the good alignment, the uniform blow, and the well-designed type. In the other key machines, it is necessary to strike an *l* or an *i* with less force than an *m* or a *w*. The blow in this machine is given from the back of the paper, the inking ribbon being on the other side, between the paper and the type. It might be imagined that it would not print on stout paper, but it will just give a fair impression on a thin post-card. The feed for moving up the paper for a fresh line is effected at the same time as the pushing back of the carriage, by merely pressing on a lever. It would seem that even this might be improved by providing an arrangement for moving it by a cord, passing down to a treadle, to be moved by the foot; thus leaving the fingers entirely free for the manipulation of the keys.

We have had less opportunity of examining the Crandall type-writer than any other machine, having only heard of it since this article was in type. It has two rows of keys, arranged radially as in the Hammond, which it resembles in several respects. The type are arranged on the surface of a brass cylinder. This has three different motions—a rotatory and an axial motion, as in the Hammond, produced by the letter keys and the shifting keys respectively; it also has a striking motion, rocking forwards to impress the type on the paper. At the back of the machine is a segment of a wheel, having grooves on its periphery. These grooves are more or less curved. Into each one the end of a key lever fits. When the key is depressed, the back end of it rises, and in so doing causes the segment to turn, the amount of motion depending on the curvature of the groove. The type cylinder is geared to the segment, and moves with it. The first action then of the key, as in the Hammond, is to bring the proper type forward into the printing position. Continuing the depression of the key, the cylinder is rocked forwards, and a small taper pin which is fixed in the frame of the machine immediately under the printing point, enters a hole in the cylinder immediately below the type which is to be printed. As the type cylinder moves forward, the pin entering the hole locks it, and finally the type strikes the paper. The system seems an improvement on the stop motion of the Hammond, but we have had no opportunity to give the machine a test, or to minutely examine the other parts. The whole of the written matter may be seen by depressing a key provided for that purpose, but one of the lines is completely hidden by a bar, as in the Barlock. An inking tape is provided, and passes between the type and the paper.

Passing now to the wheel and plate machines, we come to lighter, cheaper, and more portable type-writers; but what we gain in these advantages, we lose in speed. In a busy office, or for transcribing shorthand reports for the press, speed may be of the greatest desideratum; and a practised operator will, as we have said, write eighty words a minute. Many clerks who spend most of their time in writing with a Remington, can produce sixty to seventy words a minute, though these will probably include several blunders which have to be corrected afterwards. The strain of such work is, however, more than most authors would find compatible with their intellectual efforts, or most secretaries with their dignity.

The *Columbia* is a neat little machine, only 9 by 6 by 5 inches, and weighs $3\frac{1}{2}$ lbs. The work produced by it is superior to that of other type-writers, for it has an automatic spacing arrangement, which allows a smaller side motion of the carriage for a narrow letter than for a wide one. A test for this is the writing of the words

committee, commission, willing,

which most type-writers print as above, but which are produced by the Columbia in a style which much more nearly resembles ordinary print.

The motion is quite unlike that of any other machines, and is rather difficult to learn. A type-wheel carries the type in a single row round its periphery. A handle projecting from the wheel is twirled backwards and forwards by the finger and thumb; a movement which can be produced with any amount of rapidity, but which is rather hard to effect with certainty of stopping at the right point. An improved form of this machine has an adjusting screw, by which a certain amount of friction can be applied, and which must be arranged to suit the strength of the operator's fingers. The type-wheel is geared to an index which travels round on a dial facing the operator. The upper part of the machine, as in all those of the second class, travels along step by step to the right. The distance travelled is regulated by the thickness of the type-wheel at the point where the type, which is in the printing position, is set. This method of regulating the feed is very simple, and does not complicate the machine, though it would be very difficult to apply it to most type-writers. The type-wheel is carried on an axis which is hinged at the left-hand side of the machine, and which can be depressed so as to bring the type down on the paper, the pressure being applied by the handle which is used for twirling the wheel.

The Columbia does not profess to be a fast machine.

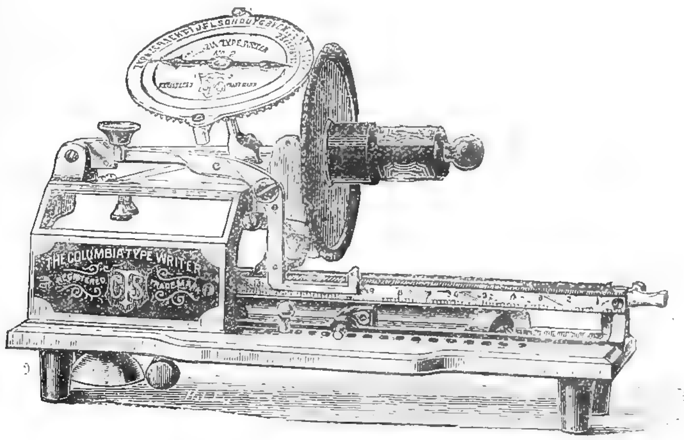
The type are of metal, and are inked by a wheel covered with cloth. When the type-wheel is at rest, the inking-wheel hangs between the type and the paper; when the handle is depressed, the inking-wheel moves out of the way, returning when the type-wheel rises. Each letter is thus inked before and after printing, and the same letter may be repeated a number of times with uniformly black impressions, with the exception of the first, which is generally darker. This somewhat defeats the object. The writing can be seen tolerably well.

The use of ink gives a much sharper impression than can be obtained from a tape, but the writing is equally liable to be blurred by rubbing, unless copied in a copying press as soon as it is written. This has a drawback to which makers of type-writers should turn their attention. Inking tapes are sold which give a capital black impression, but which will not copy; while the copying tapes, though giving a good and indelible colour after being copied, are both faint and easily smudged if not copied.

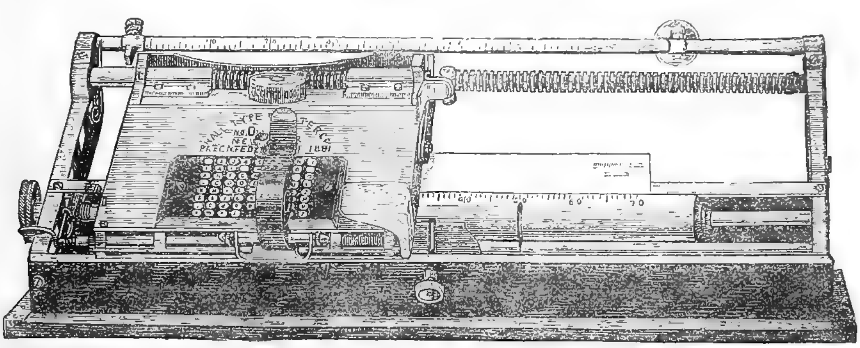
The *Hall* type-writer was one of those which suffered at first from being placed in the market before it was ready, though it was more complete when first introduced into this country than some of those which we have already described. Several improvements have been effected which no doubt make it a more durable machine than the two specimens which the present writer used daily for several years. The first one becoming worn out, there was no way of having it repaired but sending part of it back to America, but another machine was found also sadly out of order, and between the two a new one was patched up.

As in the Columbia, the paper remains stationary during the printing of each line, while the upper part of the machine moves step by step to the right. The types are formed of soft rubber on the face of a sheet of that material, being arranged in nine rows of nine characters. The plate is attached to a system of link work forming a double parallel motion. The plate can thus be moved in any direction, but always remains parallel to itself. Beneath the type plate, that is, between the plate and the paper, is an inking pad, which can be lifted out. In the centre of the pad is a square hole, through which one type at a time can be pressed on to the paper benaeth. At each stroke, therefore, all the other type are being pressed on the ink pad. The result is that if the same character be printed several times in succession, impressions rapidly become faint. In practice this inconvenience is not often felt, but the machine will not print "1,000,000" without a good deal of trouble with the inking of the "o."

The motion of the type plate is controlled by a bar, furnished with a hinged handle which carries a conical pointer. The handle therefore carries with it the type within the limits of an index plate. In this plate are nine rows of nine holes, corresponding to the arrangement of the type. At the bottom of each hole appears a letter. When the conical pointer is pressed into any hole, the type corresponding to the letter is brought opposite the square hole in the inking pad. On applying pressure, the whole carriage is depressed on to the paper, and the soft rubber of which the type plate is composed, allows the proper type to protrude through the hole. On the under side of the cover or lid of the carriage is a flat-headed pin, which is fixed exactly opposite the square hole: this gives the pressure on the type.



THE COLUMBIA TYPE WRITER.



THE HALL TYPE-WRITER.

It might be supposed, not only from this description, but from a trial of the machine, that it would be impossible to write at any considerable speed. While not attempting to rival the key machines, there is little difficulty in attaining forty words per minute, after several months' use; but it is necessary to have a very good light. Plenty of light is needed for working any type-writer in comfort, but for the Hall it is specially necessary, since the letters are at the bottom of holes in the index-plate. Two improvements have recently been introduced to meet this difficulty, but they by no means remove the defect. The weight of the machine, in its wooden case, is only 7 lbs. The type-plate can be readily changed for one of another style, there being a considerable variety. A type-plate of sufficient hardness to produce "manifold" copies, has been promised for some years, but had not made its appearance on the occasion of our visit to the agents; though several improvements appear to have been made with the view of reducing wear and tear.

It is possible with this machine to use the comma as an apostrophe, or to combine two vowels to make a diphthong, or to raise the *r* of Mr. by depressing the carriage while the pointer is not fairly in the hole, but is forced to one side. A disadvantage, however, arises from this peculiarity, for if the pointer is not held with a very light hand, allowing it to go straight into the hole in the index-plate, without any side strain, the result will be an irregularity in the printing, and a want of alignment. The Hall is of very simple construction and few parts.

The last type-writer on our list is the *World*, and it stands on the borderland between machines and toys. It cannot boast of speed, but an hour's experiment with it is sufficient to show that it may be classed among the more elaborate machines that have been mentioned. Its chief merit undoubtedly is that its price is about one-tenth of the key machines. The paper is passed under a bar and over a rubber roller.

The type are arranged on a soft rubber segment which is connected to an index-handle, and are moved over an index-plate by the right hand, while the left is used to depress a bar, which brings the type down on the paper, and pushes the carriage on for the next letter. The inking is effected by means of a pad on either side, over which the type-segment is continually sweeping. Considering its price, and that it measures 12 inches by 6, weighing $3\frac{1}{2}$ lbs., it is very possible that it may be worth getting when time and trouble are of little consideration.

The first cost of the type is a serious expense in the construction of a type-writer. Several letters have to be specially cut, the *g* and *y* having shorter tails than usual, and the *m* and *w* have to be a little cramped. Considerable skill has been expended on the arrangement of the keyboards and indices, with the view of placing the letters which are in most frequent use in the most convenient position. If this were all, the arrangement would be simple enough, but care is also taken in most machines to place near to each other letters which often come together. In the following examples, the characters which may be produced by depressing changing keys are not given. The Remington keyboard is arranged thus:—

lower case
2 3 4 5 6 7 8 9 -
· O W E R T Y U I O P
A S D F G H J K L :
upper case Z X C V B N M , .

The Hammond thus:—

Z Q J B P F D cap. fig. T H R S U W V
? X K G M C L , spaces . A E I O N Y :

It will be seen that the word *the* is easily written by striking the *t* with the first finger of the right hand, the *h* with the second finger, and the *e* with the same finger, sliding off the upper row on to the *e* below.

The keys for the words *that, these, their, on, is,* come together in a very convenient manner.

In the Hall type-writer, the index moves with the carriage to the right after each letter is printed. The arrangement of the characters is therefore from right to left.

1	2	3	4	5	6	7	8	9
o	"	"	§	‡	†	*	£	$
K	B	F	G	N	I	A	S	Q
J	C	D	O	E	H	T	W	V
X	M	Y	L	&	R	U	P	Z
k	b	f	g	n	i	a	s	q
j	c	d	o	e	h	t	v	w
x	m	y	l	.	r	u	p	z
[	$\frac{3}{4}$	'	;	,	-	?	:	]

In printing the word *the*, the pointer is pressed into the hole marked *t*, and, on releasing the pressure, the carriage moves on a step to the right, thus bringing the *h* under the pointer, which need not be moved at all; the *e* follows the *h* in the same way. The frequent termination, *ing*, presents itself to the hand in the same way. The characters *th, in, ly*, are also arranged with the same view.

Since writing the above, we have sought to supplement our personal experience and the glowing account of their own machines which all agents are so ready to give, by a visit to the Westminster Type-writing and Shorthand Office, at 2, Victoria Mansions, Westminster. This is one of the already numerous establishments which is conducted entirely by ladies, for whom, if work they must, no work could be better adapted. In this office a special point is made of perfect accuracy, and we are surprised to hear that a speed of about sixty words a minute is generally kept up. When the subjects undertaken are, one day, sermons; another, copies of actors' parts of plays; then a surgical MS. bristling with technicalities—besides all kinds of legal work and authors' "copy"—even this speed must entail a good deal of close attention and care.

Should any of our readers feel that they have arrived at that time of life when it is their duty to society to publish their "reminiscences," they need only send for a lady who will take down the matter in shorthand and send it back in print, this being a class of work undertaken by the office we have mentioned; nor will they be unprepared if the work is to be translated into Russian or Hindustani.

A Remarkable Meteorite.—The heaviest purely metallic meteorite as yet known is the "thunderbolt" of the Arab Sheik Kalaph Ben Assab. This chieftain saw it falling in the Valley of Kalede, in Central Arabia, in the year 1863, and presented it to the Persian Governor of Bunder Abbas. The latter sold it, along with a formal attestation of the finder, to the English authorities, and it has since been chemically examined. It consists of 91·04 per cent. of iron, 7·40 nickel, 0·66 cobalt, traces of copper, phosphorus and sulphur, and 0·39 of amorphous carbon. It contains no stony matter, and only includes scattered traces of troilite and graphite. Its weight is 120 lbs., and it is consequently the largest purely metallic meteorite or "holosiderite" known. The meteorite of Pallas, now in the St. Petersburg Museum, is much heavier, but it contains many cavities filled with olivine, and is consequently a "syssiderite." It is the tenth meteorite which has been seen actually descending. It fell during a thunderstorm, and made a deep hole in the earth.

General Notes.

Basic Slag in Agriculture.—The quantity of "basic slag," the by-product of the Gilchrist and Thomas process, now consumed annually by farmers in Germany reaches 300,000 tons.

Locusts in Madagascar.—Father Paul Comboné (*Cosmos*), writing from Tananarive, mentions that Madagascar is at present visited by the "Valala" (*Pachytylus migratorioides*), a species distinct from the locusts of Algeria and of Western Asia. They are eagerly eaten by the natives, and are consequently not regarded as a scourge. They are captured by the uneconomical process of setting fire to the herbage upon which they alight.

The Height and the Speed of Waves.—The subjects have been re-investigated by Mr. Buchanan, formerly of the *Challenger* staff, during a sounding voyage on board a steamer belonging to the Indiarubber, Gutta-percha, and Telegraph Works, Silvertown, a vessel commissioned to study the track for laying a submarine cable to St. Paul de Loanda. Mr. Buchanan's observations were made near the island of Ascension, the wind being so violent that the signals were hoisted to warn ships from attempting to enter the harbour. The height of the waves was determined at 20 ft., the mean distance from crest to crest at 625 ft., and the speed from 23 to 25 miles per hour.

The Electric Cultivation of Plants.—It has been frequently asserted that electricity applied at the roots of plants or to the soil in which seeds are sown should be a powerful promoter of vegetation. Professor Wollny, of Munich, has submitted this question to the test of experiment. He surrounded plots of ground, each of rather more than a square metre of surface, with boards, sunk in the soil to the depth of a foot. In one of these he arranged two earth-plates connected by a conductor, in which he introduced a battery of five elements; in another he placed an induction apparatus, and in a third a plate of zinc on the one hand and a plate of copper on the other, so as to form a natural element. Peas, potatoes, carrots, etc., were planted in these enclosures, and it was found that the application of electricity, either at a high or a low potential, proved either inert or injurious. Professor Wollny believes that electricity occasions perturbations in the protoplasm of plants, the greater in proportion to the conductivity of the sap. He infers from his experiments that electro-cultivation has scarcely a future.

The Laboratoire d'Erpetologie at Montpellier.—This establishment is for the purpose of effecting the sale and exchange of serpents and other reptiles and amphibia. Any traveller can here dispose of living specimens. It has 147 members in Europe, and 203 in other parts of the earth. The purpose of the association is to furnish the members with reptiles and amphibia at cost price, in order to facilitate their study. The superfluous specimens are disposed of to outsiders, and the profit is applied to the purposes of the society. Every member pledges himself to write yearly at least two memoirs on reptiles, which are to be published in any journal. The society possesses an "Encouragement Fund," endowed by certain members for the purpose of sending out young naturalists to countries not sufficiently explored, in order to collect and to make observations. Prizes, such as, *e.g.*, a Zeiss microscope, are awarded for the best collections. Rare animals can be lent for observation to any member who can prove that he has accommodation for such specimens, on condition that he publishes his results.

The Public Health.—The Registrar-General's return for the week ending December 15th shows that the deaths registered during that period in twenty-eight great towns of England and Wales corresponded to an annual rate of 18·9 per 1,000 of their aggregate population, which is estimated at 9,398,273 persons in the middle of this year. The six healthiest places were Halifax, Brighton, Hull, Bristol, Sunderland, and Wolverhampton. In London 2,291 births and 1,455 deaths were registered. Allowance made for increase of population, the births were 452, and the deaths 404, below the average numbers in the corresponding weeks of the last ten years. The annual death-rate per 1,000 from all causes, which had been 16·5 and 17·8 in the two preceding weeks, were last week 17·7. During the first eleven weeks of the current quarter the death-rate averaged 18·5 per 1,000, and was 2·1 below the mean rate in the corresponding periods of the ten years 1878-87. The 1,455 deaths included 154 from measles, 17 from scarlet fever, 39 from diphtheria, 14 from whooping-cough, 18 from enteric fever, 11 from diarrhœa and dysentery, and not one from small-pox, typhus, ill-defined forms of continued fever, or cholera; thus, 253 deaths were referred to these diseases, being 20 above the corrected average weekly number. In Greater London 2,891 births and 1,817 deaths were registered, corresponding to annual rates of 27·3 and 17·2 per 1,000 of the estimated population. In the Outer Ring 22 deaths from measles, and 5 from diphtheria were registered. The fatal cases of measles included 8 in West Ham and 4 in Croydon sub-districts.

Fauna of a "Pile Dwelling."—A "pile-village" on the Szontag Lake in the district between Lotzen and Lyck was examined by Heydeck in 1887, and appeared very similar in its construction to the pile-dwellings in the Arys, Czarnikock, and Tulewo Lakes. The remains were of a very remote date, as no articles of iron were found, and of bronze only a decorative disc. The earthen vessels had been made without the use of a wheel, and had very little attempt at decoration; only marks of finger-nails and a stroke in the shape of N. The very numerous bones were examined by Nehring, and were found to belong to the wolf, fox, wild cat, otter, bear, beaver, hare, wild boar, ur, stag, roe, domestic dog, horse, swine, ox, sheep, and goat; capercailzie, black cock, duck, crow, hawk, owl, and pike. The most abundant are the bones of domestic animals, especially of the pig, and the next most plentiful are those of the stag and the roe. Most of the marrow-bones have been broken. The ur (*Bos primigenius*) is represented only by the core of a horn, which shows many traces of human elaboration. From the antlers of the deer many pieces have been severed, probably for the manufacture of implements. Nehring emphasises the absence of the reindeer, which, indeed, he has never discovered in pre-historic finds, in company with the roe, pig, and tame cow. The only dog's teeth discovered are decidedly of a wolf-like type, and belong not to the "peat dog," of Rutimeyer, but to the so-called "Bronze dog." The horse-bones belong to a pony of an elegant race, which was probably domesticated. According to these remains the pile-builders lived principally by hunting and keeping cattle, in part also by fishing.

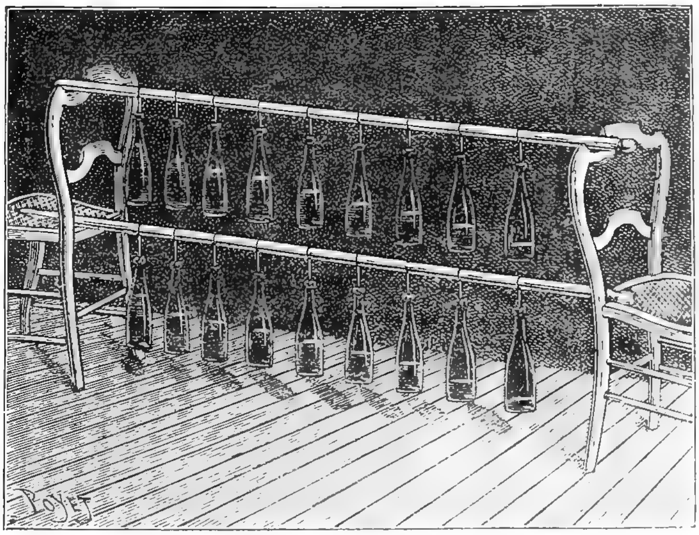
THE STATE OF OUR CEMETERIES.—Sir Spencer Wells in opening a discussion on "Cremation," in the large hall of Sion College, showed that our cemeteries are now little, if any, better than the old churchyards against which Dr. Thomas Walker waged such a long and arduous war. He said: "The present condition of many cemeteries is shocking and revolting—bodies festering in a slough of corruption, while others are covered only with a few inches of earth. The Brompton Cemetery, surrounded on every side by the dwellings of the living, was bought by the Government in 1853, ostensibly for the purpose of closing, but since then it has been receiving more than 5,000 bodies annually. The present state may be more easily imagined than described. In the Tower Hamlets Cemetery it is alleged that as many as 1,053 children's bodies have been packed in seventeen trenches, and in one instance sixty bodies in one trench, which remained open until it was over-filled. It has frequently been found necessary to bail out the liquid corruption; and owing to the foul stench the workmen engaged have been taken out of the trenches in a fainting condition. In the Wolverhampton Cemetery the common graves are kept open from day to day until quite filled. In the Ardwick Cemetery, Manchester, with a very small acreage, 70,000 bodies have been interred. The dead lie in what are practically wide trenches with about 18 inches of earth between each. In Glasgow the system of pit burial is generally adopted, and goes on, although it has been denounced by the medical officer of health as dangerous to the public, and a gross breach of decency."

THE PROTEST AGAINST EXAMINATIONISM IN EDUCATION.—The growing conviction that competitive examinations are a ruinous failure has found able and authoritative expression in the November issue of the *Nineteenth Century*. In that issue we find "the strong protest of the signers against the dangerous mental pressure and misdirection of energies and aims which are to be found alike in nearly all parts of our educational system. Alike in public elementary schools, in schools of all grades and for all classes, and at the universities, the same dangers are too often showing themselves under different forms. Children are treated by a public department, by managers and schoolmasters, as suitable instruments for earning Government grants; boys of the middle and richer class are often trained for scholarships with as little regard for the future as two-year-old horses are trained for races; and young men of real capability at the universities are led to believe that the main purpose of education is to enable them to win some great money prize or take some distinguished place in an examination. We protest most emphatically against such a misdirection of education, and against the evils which necessarily arise from it." This document has been signed by hundreds of the most thoughtful and influential persons in Britain—men widely differing, or even mutually hostile on perhaps every other subject, but here joining in a protest against a system which, if persisted in, must reduce us to intellectual ossification. Professor Max Müller, commenting on this document, admits that he was, forty years ago, an eager advocate of the system of Civil Service examinations. He now frankly owns his mistake, and admits that the fault has been, not with the application of the principle of examination, but with examination itself. Mr. Frederic Harrison thinks that "examination, having been called in to aid education, has grown and hardened into the master of education. Education is becoming the slave of its own creature and servant. Like all servants turned masters, it is now bullying, spoiling, and humiliating education."

THE LAST EXPLORATIONS OF M. DE BRETTES.—M. de Brettes, of whose early travels in the Grand Chaco to the south of the Rio Vermejo a brief account has already appeared in these columns, has just returned to Paris from a second expedition, with reference to which he furnishes some interesting particulars to the *Journal des Debats*. Having started from France in May, 1886, entrusted with a mission by the Minister of Public Instruction, he was detained by difficulties of one kind and another upon American soil for sixteen months, and prevented from penetrating into the Chaco. He did not, however, allow this time to be wasted, for he purchased a yacht, and, with the help of a French engineer, M. de Boisvier, he completed the hydrographical survey of the Lake Ypa-Carai which had been commenced twenty-seven years before by the English engineers Burrell and Valpy, but interrupted by the Paraguay war in 1864. At the instigation of the Consul of Bolivia, M. de Brettes then entered the Chaco for the second time (October 13th, 1887), starting from Apa, on the frontiers of Brazil, and making for Baranquerita (the Northern Chaco). His escort then consisted of fifty Guana Indians and a single native of Paraguay who had resolved to accompany him, and who was nicknamed accordingly by his compatriots "Guapo" (the brave man). But this brave man soon took fright, and fled back to Apa half dead with terror. M. de Brettes then travelled through the territory of the Guana Indians, who were then at war with their mortal enemies the Chamacocas, and he was himself attacked by this tribe and slightly wounded. He continued his march westwards for six days, suffering terribly from thirst, and he at last reached Bolivian territory, ten days' march from Pilcomoyo, having gone through the hitherto unexplored territories of the Guanas, the Kamananghas, the Baughis, the Neennsemahas, and the Aksseks. During the whole of this difficult march he did not fail to take note of all the important geographical positions, and thus, for instance, he followed for upwards of 70 miles a *senda* (Indian path) which leads from the Rio Parguay to Bolivia across the Chaco. This was the knotty point of the problem, and M. de Brettes further ascertained that this *senda* runs through a perfectly flat country, and that there would be no difficulty in clearing the road which Bolivia so much desires to make. He also came upon some very curious brick ruins to the right of this Indian tract in latitude 21° 48′ south, longitude 63° 07′ west meridian of Paris. The Indians who accompanied him said that beneath the round monuments like low towers, which M. de Brettes saw, were tombs, but he was unable to verify this, though he extracted from some of the cavities in the ground some fine specimens of pottery similar to those found in the tombs of the Aymaras of Bolivia, whence M. de Brettes concludes that the Incas' dominion must have extended far beyond the Andes. Among the pieces of pottery which he has brought back is a duplicate of what M. Jacquemart describes as the *chef d'œuvre* of American pottery, a vase which is now in the Louvre. In addition to the potteries of the Incas his collection comprises Guanas and Chamacocas vases of modern manufacture and a great number of Indian articles, such as violins, costumes made of feathers, necklaces of all kinds, and arms.

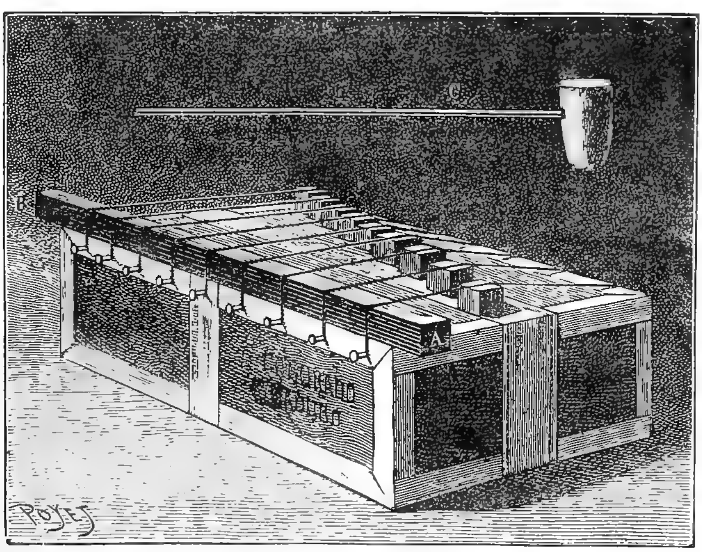
PREPARATION OF MUSICAL INSTRUMENTS.

M. L'ESPRIT has sent to *La Nature* descriptions and sketches of musical instruments which may be easily constructed of domestic materials.



MUSICAL INSTRUMENT MADE WITH WINE BOTTLES.

The first of these instruments is composed of glass bottles of any kind, filled with a certain quantity of water, the height of which varies according to the note to be obtained, as it is shown in the accompanying sketch.



MUSICAL INSTRUMENT MADE OUT OF A CIGAR-BOX.

After a few trials it will be found practicable to reproduce all the notes with their octaves, including the flats and sharps, for arranging which a musical ear is, of course, required. The bottles are suspended by their necks with double loops of string, hung over broomsticks, resting on two chairs. To produce the sound the performer uses two rods or the two sticks of a child's drum. Airs in two parts can be played on this instrument, or duets may be executed by two performers, one on each side.

The second instrument is a kind of harp. Take a flat box; a cigar box will serve, and drive into each side nails, shown in fig. 2. From the nails on opposite sides thin brass wires are stretched. Pass a square ruler under the wires from A to B (fig. 2). On the other side place small cubes, cut from a similar ruler, and find by trial the length of the cords to produce the notes required. As a matter of course, the strings must be stretched tight. To strike them when properly adjusted, a slip of whalebone (C) may be taken, to the end of which is fixed a cork.

SOME RECENTLY DISCOVERED FORMS OF MICROSCOPIC CRUSTACEA.

(*Part II., continued from p.* 622.)

Mecynocera clausi, I.C.T. Differs remarkably from every other known species in the extreme length of its anterior antennæ, by which it can be at once recognised. It is about $\frac{1}{25}$ inch in length. Its rostrum is bifid and very slender. The anterior antennæ are 23-jointed, alike in both sexes, and about twice the length of the entire animal (fig. 1); the 11th, 12th, and 13th joints of left antennæ only are edged with fine saw-teeth (fig. 2). The basal portions of both antennæ bear several short setæ and a few long ones, and at intervals, and especially at apex, are several long, whip-like setæ. The posterior antennæ are very muscular; the outer branch is 3-jointed, the inner 7-jointed, and terminated by spreading setæ. The maxillæ are well developed, with

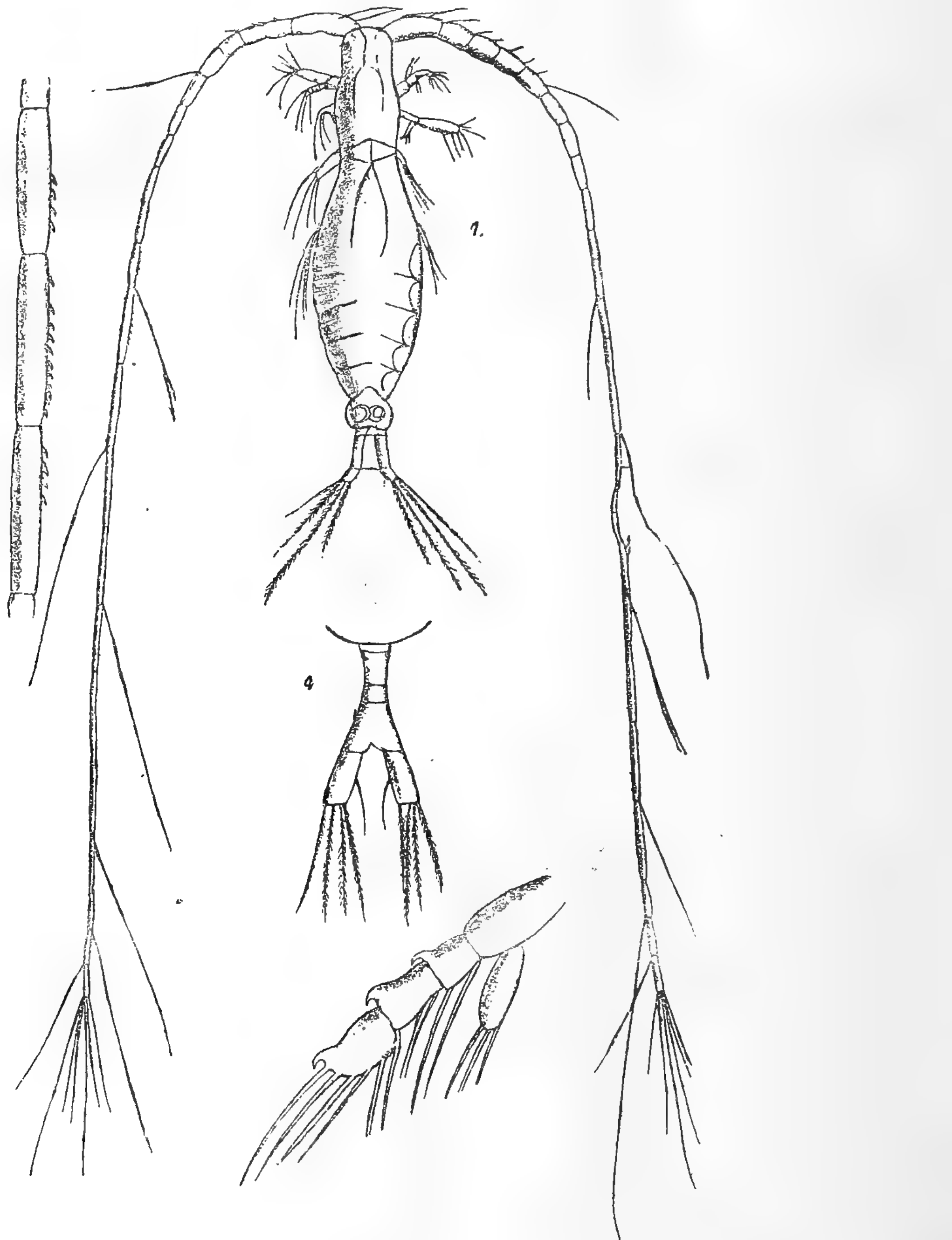


PLATE VI.

Fig. 1. *Mecynocera Clausi*, I.C.T., female. × 250.
Fig. 2. Eleventh, twelfth, and thirteenth joints of left anterior antenna of ditto, showing saw-teeth. × 400.
Fig. 3. Fourth swimming-foot of ditto. × 400.
Fig. 4. Abdomen and caudal segments of male ditto. × 400.

two spreading setiferous branches and broad rounded palp. The anterior foot-jaw is 3-jointed, and like the posterior, which is small, bears a large number of plumose setæ.

The swimming feet (fig. 3) have small hooked spines at ends of joints, but no terminal spines besides abdominal joint is divided longitudinally, the intervening space being filled with hyaline membrane. The caudal terminations in the female are divergent, in the male less so; both are terminated by four plumous setæ on each side. Colour reddish brown.

Males and females were both plentiful, and taken by

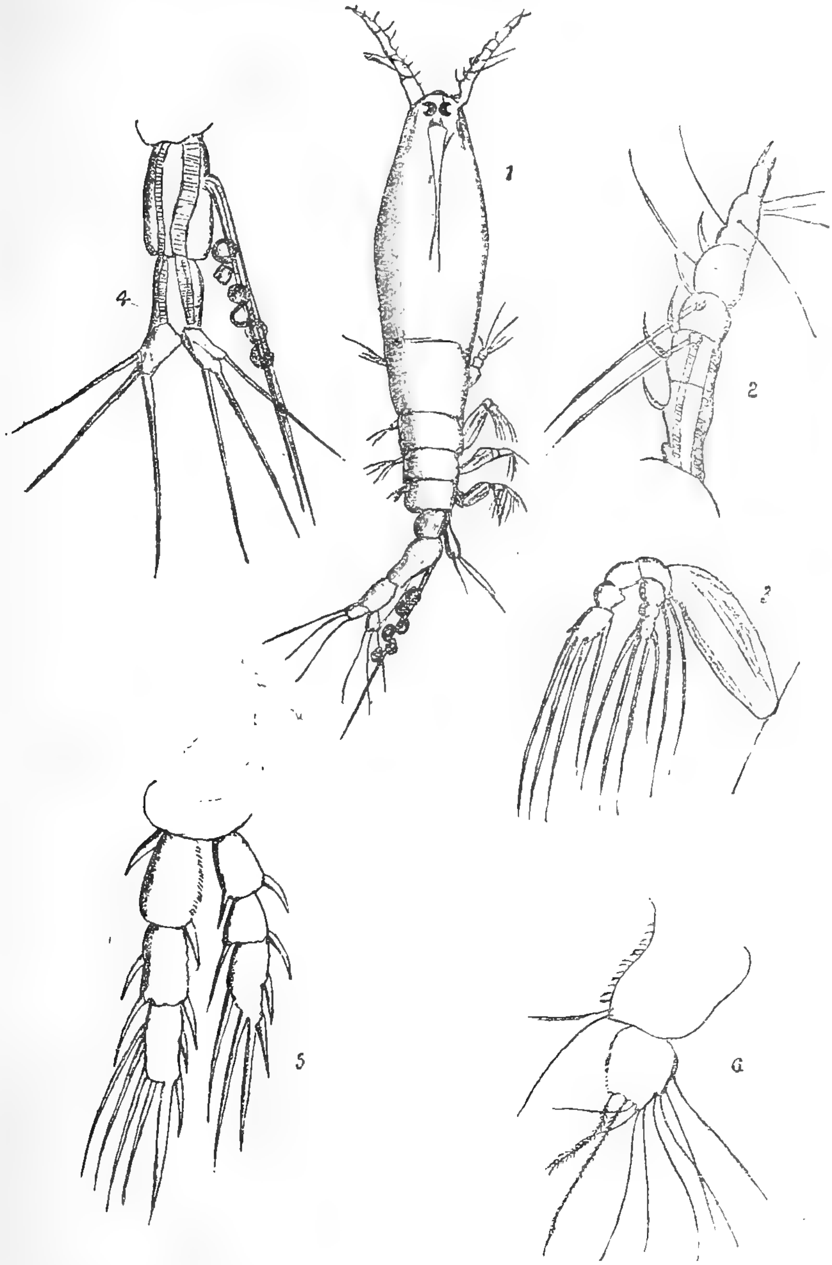


PLATE VII.

Fig. 1. *Cymbasoma rigidum*, n. sp., female. × 250.
Fig. 2. Anterior antenna of ditto. × 400.
Fig. 3. First swimming foot of ditto. × 400.
Fig. 4. Abdomen of ditto, with attached ova and caudal appendages.
Fig. 5. First pair of swimming-feet of *Acontiophorus angulatus*. × 400.
Fig. 6. Fifth foot of ditto. × 400.

the strong spinous setæ. The fifth feet are wanting in both sexes. The abdomen of the male (fig. 4) is 4-jointed, that of the female is 3-jointed, the basal joint of the latter being somewhat heart-shaped. The third

surface tow-net at all the places visited. Indeed, this species seemed to be more widespread than any other.

Cymbasoma rigidum, I.C.T., plate vi. In the earlier portion of this paper a short description was given of the new British species *Cymbasoma Herdmani*, I.C.T. The form about to be described was, however, the earliest found, and the writer has since also found it in the Maltese seas. Its length is about $\frac{1}{8}$ inch. The first joint of the cephalothorax (fig. 1) is equal in length to the succeeding five, the last being much smaller than the others, and appearing as though part of the abdomen. The eyes are long and kidney-shaped, with a conspicuous brain below. The anterior antennæ (fig. 2) are about eight times as long as the broadest part, and terminated by two claw-like spines; the inner side of each antenna has five hooked spines (fig. 2). From two raised circumferences near the centre proceed long spinous setæ, and several smaller setæ are situated near the apical portion of the antennæ. The first four pairs of swimming feet (fig. 3) have strong muscular basal joints, from which proceed two 3-jointed branches, with thick terminal setæ. The fifth pair of feet are each composed of a long joint, at the apex of which are three strong spinous setæ. The abdomen is very muscular; the caudal setæ are short, broad, and divergent, and are each terminated by three strong setæ.

One specimen only, a female, was taken in the tow-net, at Orotava, Teneriffe.

The lower portion of the body is of a deep sepia colour. The animal is peculiarly rigid and muscular.

The illustrations accompanying the paper are taken from Mr. Thompson's drawings in the Transactions of the Liverpool Biological Society and the Linnæan Society of London.

THE GEOLOGICAL HISTORY OF SHARKS.

IN the Suffolk Crag great numbers of sharks' teeth occur, and among these are many of large size, which bear the name of *Carcharodon*. They are often upwards of four inches in length, triangular in outline, and armed along the cutting edges with close-set toothlets, such as are so often found upon the large knife-like teeth of carnivorous animals. The great sabre-toothed feline (*Machairodus*) of our late tertiary times, and the extinct carnivorous reptile *Dicynodon* of South Africa are well-known instances of the same thing. It is plain that a tooth so armed lacerates the flesh more extensively and completely, penetrates further, and is more easily withdrawn. A knife-blade passed into soft wood, or cheese, or flesh, soon jams, and can hardly be moved backwards or forwards; but if the edges are furnished with saw-teeth, the tool enlarges its cut, and will penetrate much deeper. Teeth of the Carcharodon occur also in the tertiary deposits of Florida and Carolina. In some places they are so plentiful that ship-loads are regularly sent to England for conversion into super-phosphates, the same process being, as our readers well know, applied to the fossil bones and teeth of the Suffolk Crag. Many of these fossil teeth were dredged up from the bottom of the Pacific during the expedition of the *Challenger*. A closely-allied species (*Carcharodon Rondeletii*) still survives in the seas of warm climates. It attains the great length of forty feet, but the tertiary shark of the same genus must have exceeded even this enormous bulk. The recent and fossil teeth hardly differ materially, but of course there may have been more conspicuous differences in the perishable parts of the body, with which we cannot hope to become fully acquainted.

Agassiz and other palæontologists have described many kinds of large crushing teeth borne upon the jaws of very ancient sharks. Some are known from the Devonian formation. A vast number of forms have been figured from the limestones of the Carboniferous period, and the succession lasts, with hardly diminished numbers, down to the Lias, after which there is a great falling off in the variety and frequency of these fossils. The key to the arrangement and use of such teeth has been found in the recent *Cestracion Philippi* of Port Jackson, a shark whose fore teeth are pointed and adapted to the seizing of prey, while the hind ones form a tessellated pavement, set with regular rows of large and powerful grinders, which are rendered intensely hard by the dense enamel which covers the exposed surface, and yet to some extent movable by reason of the membranous spaces between. This dentition is well suited to the crushing of crustacea and hard-shelled mollusks.

Among the oldest sharks are some whose teeth were subdivided into several long-pointed cusps, smaller ones sometimes intervening. These belong to the extinct genus *Cladodus*, which is first met with in Devonian rocks. Quite recently Garman has described a very peculiar deep-sea shark from Japan, to which he gives the rather repellent name of *Chlamydoselachus anguineus*. It has an unusually long but nevertheless shark-like body, a wide mouth opening quite at the fore end of the head, as in most fishes, and not beneath, as is usually the case with sharks. The gill-openings are extremely wide in comparison with any other shark. The teeth closely resemble some of those attributed to *Cladodus*, and good naturalists could be named who maintain that the old Devonian fish still survives in the Japan seas. Others believe that the form of the teeth in sharks cannot possibly justify a confident assertion of identity, but there can be little doubt as to the near affinity at least of the creatures separated by so vast an interval of time.

The oldest known sharks are also among the oldest known vertebrates. They are represented by teeth, scales, and possibly spines found in the bone-bed of the Ludlow formation (Upper Silurian). Some long extinct fishes (*Pteraspis*) claim an equal antiquity, but no surviving form of vertebrate life can be traced back anything like so far as the family of sharks.

Upon this remarkable persistence of an extremely ancient type we have to make two remarks. Firstly, that it is in singular conflict with the general course of life upon the earth. In seas, as in wide continental areas, there is a profusion of competing forms; new races appear frequently, and spread fast; ancient types are suppressed, or driven out into secluded regions. We find that the truly ancient families among animals are now to be sought chiefly in ponds and lakes and rivers, even such as once could hold their own in the broad ocean. But the tide of time has not exterminated the sharks, nor even compelled them to take refuge in corners. They are still numerous, varied and widespread—truly a dominant race, notwithstanding the lapse of uncounted ages.

In the second place it is not a little startling to find in sharks rudiments and embryonic structures, not serviceable to the animals themselves, though immensely interesting to the naturalist, who learns thereby something about their yet more primitive pre-Silurian and invertebrate progenitors. The external gills, which never serve to aerate the blood, and the early stages of the development of the kidneys will remind comparative anatomists of the details of structure to which we point. We should have expected that natural selection, working through untold ages, would by this time have simplified the course of development, finding out short cuts to avoid waste of tissue and waste of time in the assumption step by step of the permanent organisation of the body. But purposeless embryonic arrangements, which point to Annelid ancestors, are still preserved, to the conspicuous advantage, we must gratefully acknowledge, of the biologist, who thus finds some of the most difficult channels of phylogeny buoyed for his guidance. The succession of life on the earth follows no law of capricious change. The English constitution has been said to owe its remarkable character to the circumstance that Englishmen have never changed their institutions, except to remove a practical grievance, and only to just such an extent as the grievance required. It seems to be a somewhat analogous law of nature that anomalies and vestiges of an antiquated state of things are tolerated and preserved so long as they do not cost time or substance which can ill be spared. But to the student who has some hazy idea of what geological time means, the mention of structures inherited by existing sharks from pre-Silurian invertebrate ancestors loses none of its strangeness by reflection; and it is only the sheer impossibility of finding a less difficult solution which forces him to accept such an explanation of the recorded facts.

THE SOLAR ECLIPSE OF JANUARY 1.

THE total solar eclipse, which will occur on January 1, 1889, although it will not be seen in our hemisphere, will be an event of great astronomical importance. It will be fully visible in the Pacific States of the Western Continent, and the Americans are preparing to observe it. It is extremely rare for a year to open with a total eclipse. It has not occurred since 1682 (new style), and will not occur again till 2161. The coincidence has also happened in 1162, 660, and 641 B.C. and 865 and 1405 A.D., the two latter dates being of the Julian calendar. The path of totality, or complete obscurity, will cross Nevada and California over an area favourable for observation. The best places for observation in California are Point Arena, Ukiah, Bartlett Springs, Willows, Chico, Quincy, Loyalton, Oneida, Long Valley, Milford, etc. All places on or near the centre of the path will be in darkness for about two minutes of the time. At the central line, near Oroville, the totality will be 114 seconds; at Point Arena, it will be 120 seconds. It will last from 108 to 120 seconds—longer nearer the coast than in the interior. In Nevada the shadow of the moon will cross the western line at the town of Verdi, and its breadth is so great that from Verdi north along the boundary for a distance of about 100 miles there will be total darkness of the eclipse. The central point of the moon's shadow will cross the Western Nevada line at a point 32 rods north of the 124th milepost. The south edge of the moon's shadow will pass about halfway between Reno and the highest point of Peavine Mountain. Thus Reno will be just outside the shadow. The centre of the path will be about six miles north of Winnemucca, and 29½ miles north of Tuscarora. The south edge of the path will pass north of Wadsworth and south of Pyramid, Lovelocks, and Humboldt House. The north edge of the path will pass north of Buffalo Meadows, Willow Point, Paradise Valley, Spring City, Willow Creek, Cornucopia and White Rock, and will pass ten miles south of Fort McDermit.

The eclipse, from beginning to end, will be very long. For instance, at Point Arena the beginning of the eclipse will be 1 hour and 10 minutes before the beginning of totality, and the end will be 1 hour and 16 minutes after the ending of totality, the whole lasting over two hours and a half. It begins at that place at 0h. 15min. 11sec. mean time. For standard Pacific time, 14 minutes 58 seconds should be added to that. In San Francisco the eclipse will not be total, but very nearly so. About eleven-twelfths of the sun will be obscured. There it will begin at 23 minutes 7 seconds past 12 o'clock, and end at 9 minutes 6 seconds past two o'clock. The time of greatest obscurity is at 48 minutes 43 seconds past 1 o'clock. It is greatly to be hoped that there will be clear weather, though January is an unfortunate time of the year for astronomical work in that part of the world, since it falls in the middle of the wet season. The Royal Astronomical Society has published a letter of Professor E. S. Holden, of the Lick Observatory, giving the probable meteorological conditions. He gives the records of cloudiness at various Californian stations for the last fifteen days of December and the first fifteen days of January, but prefers not to express any definite opinion on a subject so uncertain as Californian weather in January. He simply presents the data. Time signals from the Lick Observatory are received daily (at Pacific standard noon) at nearly every railway station in California. On the days immediately preceding and following the eclipse they will be automatically transmitted from the standard clock, and special pains will be taken to make them useful to observing parties in the field. The observing party from the Lick Observatory intend going to Bartlett Springs with their instruments, which will include a spectroscope. Mr. Burckhalter (Chalot Observatory) and party will go somewhere between Cloverdale and Ukiah. Mr. Blinn (Blinn Observatory) will go to Winnemuca Peaks, Nevada. Professor Davidson (Davidson Observatory) will probably go to some point in Nevada, in the hope of getting good weather. It is expected that a number of eclipse expeditions will be formed in the east and go to California, and some observers are expected from Europe. Photographers will accompany all these parties. Members of the Pacific Coast Amateur Photographic Association are making preparations for the event, and will occupy different points along the line of totality.—*Iron.*

SCIENTIFIC AIMS.

PEOPLE who occupy themselves with heat and light and electricity, or with plants and animals, or who mix solutions in test-tubes and see what colours are produced, or who take daily readings of the thermometer and barometer, all claim some kind of place in the world of science. These and other employments of the same kind are for many purposes conveniently distinguished from purely literary, and also from purely practical pursuits. But no definition of science can hold water which takes account merely of the sort of object concerned. It is possible to play with scientific instruments, to buy and sell them, to use them ignorantly, to treat them as charms, works of art, or means for the gratification of the senses. If we mean to use language carefully, we must look for the essential character of a man of science, not so much in the things with which he is concerned, as in his aim and method. Whoever strives diligently and successfully to attain to knowledge of the laws of nature by the observation and interpretation of the phenomena of nature, may claim to be a man of science. So possibly may others too. Our definition does not pretend to be complete. It excludes the student of arithmetic and algebra, whom most people take to be occupied with science. But any definition of science which includes these, includes logic too, and becomes so wide and abstract as to have little or no practical value. Let us keep to our confessedly incomplete definition, which is right and definite as to what it includes, though probably not as to what it excludes.

Is it merely a question of words which we are raising? Not if we are engaged in clearing up our notions as to the characteristics of a particular sort of productive workers, and of the way in which they become productive. Let us give that turn to our discussion. Have any men signally promoted the increase of natural knowledge in any other way than by combined observation and interpretation of natural phenomena? Some of us will be inclined to say, Yes. We shall think of men who have heaped up stores of information for the use of others, men like Schwabe, with his fifty years' observation of sun-spots, or Flamsteed, with his catalogue of of 2884 stars. We cannot refuse such men a place among productive scientific workers. They worked with scientific tools and for scientific ends, even if they only collected information for other men to use. Well, then, what about the meteorological observer, who daily, at 9 and 3, or 10 or 4, sets down the readings of the thermometer and barometer? Is he a man of science too? We must concede that he is in intention, at least. Whether he is in fact will depend upon the use to which his observations are put. If they accumulate and fill portfolios, until improved methods drive them out of notice without leading to a single generalisation or prediction, we must refuse to confer upon the observer a place among productive workers for science. He has merely piled up observations which nobody has been able to use.

We have entered upon this discussion because we have reason to believe that thousands of patient observers are busy in the name of science with toilsome work of this kind, work which is and will remain unproductive, because unstimulated by any questions of interest to science. In many a quiet parsonage and country-house recorders have been long at work with a patience which only requires the inspiration of a clear and definite object to make it highly respectable. They hoped, and still hope, that they are collecting data useful to scientific meteorology, but, alas! the meteorological discoverers of the century, Redfield and Buys Ballot, and Buchan, have put and answered the great questions without their help.

Will it be so with the thousands of diligent naturalists who are preparing county lists? They believe themselves to be storing up valuable facts for the use of future generations. Have they any definite ground for their belief that the discoverers of some future age will care for their tables and lists of species? Hitherto the scientific study of distribution has led men like Wallace and Huxley to merge the British Isles with Europe and North Africa and most of Asia, and perhaps with North America, in one vast northern province. The smallest scientific subdivision of that natural history region includes ten times the area of the British Isles. Will the naturalist of the future ever treat scientifically units so small as 100 square miles of British land, defined by no natural barriers, and without characteristic species? If this is extensively done, there may be hope for the list-compiling naturalist, but it may be doubted whether there is any room for so encouraging a supposition. We shall perhaps be told that scientific questions continually arise which require the collection of hosts of minute facts, and the assertion is justified by the whole history of science. But would it not be better to put the questions first and collect the information actually wanted to answer them? Life is too short to prepare elaborate answers to questions which have never been, and perhaps never will be raised. The local naturalist who works with definite questions in his mind will work to profit. Without such questions he will probably beat the air. How great and desirable a change would come over our field-clubs if we ceased to record occurrences of species in small areas of arbitrary definition, and began to inquire why particular species are limited to certain spots. Why does a particular alga or dipterous larva haunt one stream only in the neighbourhood? Will it bear transportation? Is it a matter of food, or purity of water, or of enemies? What tempts the wall-rue fern to occupy the crevices of an old wall? Is it because of the lime in the crumbling mortar, or because of the nitrates, or because of a special exposure, or because of right conditions of moisture? In attempting to answer such questions the student will be tempted to observe and compare his experiences. He will work to purpose, with a definite object and with his attention well awake. How unlike the paralysing occupation of setting down a list of species with localities, studying the features of every capture merely so far as is necessary to apply the long Latin or Greek name without error, and trusting to a long-distant morrow for the recompense of labour which hitherto profits no one, and may never benefit a single student of nature. "To place stuffed birds and beasts in glass cases, to arrange insects in cabinets, and dried plants in drawers," says Sir John Lubbock, "is merely the drudgery and preliminary of study." May we not speak even more coldly of the cataloguing of names and localities? He goes on to say that "to watch their habits, to understand their relations to one another, to study their instincts and intelligence, to ascertain their adaptations and their relations to the forces of nature, to realise what the world appears to them—these constitute, as it seems to me at least, the true interest of natural history." It is such wise words as these which we would impress upon the young naturalist who has not yet finally chosen his path. We would entreat him to inquire whether the pedantry of natural history has not proved just as barren of results as the pedantry of classical scholarship, and whether what is most fascinating in natural history, namely, the attempt to solve questions of real human interest, is not at the same time the truly scientific side of the subject.

INSECT ARTILLERY.

SOMETIMES, when one is wandering along a river bank, and turning over such large stones as may lie near the edge of the water, a very remarkable sight may be witnessed. Out rushes a handsome little blue beetle with a red thorax and red legs, evidently in a violent hurry, and makes for the nearest place of concealment; and as it hurries along a puff of bluish-white smoke proceeds from its body, probably succeeded by another, and that again, perhaps, by a third; and each is followed by a slight but perfectly audible report. If the insect be interfered with, the process is repeated, it may be, ten or a dozen times in rapid succession, and one is irresistibly reminded of a war-vessel in full retreat, whose stern guns nevertheless keep up a constant fire upon her pursuer.

This curious little beetle is popularly known as the Bombardier, and scientifically as *Brachinus crepitans*, and may be considered as a typical example of the tolerably large genus to which it belongs. It is plentiful enough in some places, but correspondingly rare in others, and is usually found, if at all, in the neighbourhood of water, and particularly on or near the banks of running streams. And it affords us an excellent example of one of the very strangest methods of defence to be met with in the whole of the animal kingdom. Its discharges are, without hyperbole, those of insect artillery. They are due to a highly volatile liquid, secreted for its special function by special glands lying in the region of the tail, which passes into vapour immediately upon coming into contact with the air. They are intended for defensive purposes in combating various foes, and more especially in warding off the attacks of the larger *Geodephaga*. And they have even something of the missile nature, inasmuch as the explosive fluid itself is highly irritant in character, and will even leave a dark stain upon the human skin, which cannot be removed even by frequent ablutions.

For our knowledge concerning both this fluid and the organs which distil and discharge it we are chiefly indebted to the researches of M. Léon Dufour, who devoted special care and attention to their examination. And from him we learn that the apparatus in question is double, one division lying along either side of the abdomen, and each consisting of two parts, the one secretory, and the other conservatory. The first of these assumes the form of a delicate thread, and is, in fact, a gland in what may be termed its primitive or lowest condition; the other is a kind of reservoir, in which the fluid is stored up until required for use. And the former opens into the latter just as the secreting-glands of the bee and the wasp open into the bag which contains the poison.

In appearance the secretory portion of this gland varies very considerably, according to its degree of expansion or contraction. When fully distended it is oblong, semi-transparent, and nearly filled with air, and occupies nearly the full length of the abdomen. When contracted, however, it becomes merely a soft, opaque, whitish body lying in the terminal abdominal segments, and scarcely recognisable for the same organ. The reservoir does not change its form in like manner, but is always a globular, reddish-brown object, situated in the anal segment, and provided with special muscles to ensure its due contraction when a portion of the contents is to be expelled.

By turning the abdomen from side to side, the *Brachinus* can direct its discharge with some little accuracy, and seldom fails to check a pursuer, provided that it be at tolerably close quarters. In this manner, in its Continental habitats, it frequently contrives to repel the giant *Calosoma sycophanta*, one of the largest of the predacious "ground" beetles, and a terrible enemy to insects smaller than itself. One well-aimed discharge and the *Calosoma* relinquishes the chase, evidently suffering very considerably from the pungent nature of the volatile fluid which has been employed against it. And in our own country several of the larger *Carabi*, and such fierce and insatiable creatures as the shore-loving *Broscus cephalotes*, are frequently repulsed in like manner.

The exact nature of the explosive fluid seems rather doubtful. It is readily soluble either in water or alcohol, and leaves a slight dust behind it after discharge. And the interior of the reservoir, if that organ be emptied and examined, is seen to be covered with a deposit of the same character. It is strongly irritant, as has already been stated, and, should it enter the eyes, will cause pain and inflammation fully as severe as would an equal quantity of the strongest vinegar. And it will stain any part of the skin upon which it may happen to fall, and that so deeply that its traces will remain uneffaced for several days to follow.

Still more potent is the same fluid in the larger exotic species, some of which can scarcely be held in the naked hand, so severely do they burn the flesh. If the discharge of our common British example is similar in its effects to strong vinegar, that of its tropical relations approaches very nearly to nitric acid. And both Lacordaire and Burchell, the African traveller, tell us that they have often been obliged to release specimens which they had captured, merely because the pain caused by their discharges was so intense.

By slightly compressing the abdomen the explosions can be produced even after death, provided, of course, that sufficient time has not elapsed for the tissues to harden, and the fluid in the reservoirs to dry up. If they be directed upon a sheet of white paper, a reddish spot is left, which afterwards changes to brown. And, after the explosive liquid itself is exhausted, "a black, grainy liquid" is discharged in its place, which does not pass into vapour. In *Brachinus displosor* a similar liquid, but of a yellow or brownish colour, is emitted after the explosive discharges have ceased.

The quantity of liquid secreted, or at any rate the amount expelled at each discharge, varies very considerably in different species; and thus we find that, while our own British Bombardier can produce eighteen or twenty explosions in rapid succession—although each is perceptibly more feeble than its predecessor—*B. displosor* is limited to twelve or so, and other species to fewer still. But it is difficult to ascertain these facts with any degree of accuracy, for the simple reason that it is impossible to tell whether the beetles selected for experiment have not lately made use of their strange capabilities, and so partially exhausted the contents of their reservoirs.

Besides *Brachinus*, there are one or two other genera of beetles which possess similar powers, and among these may be mentioned *Paussus*, resident principally in the Moluccas, and certain species of *Cerapterus* and *Oxœna* But in none are they so strikingly pronounced as in the true Bombardiers.

Now what are the analogies of this fluid? Is it connected with, or a modification of, the sexual secretions? Or is it a special provision, restricted to the comparatively few insects in which it appears?

Scarcely the former, one would think, for it is present both in male and female, and it is scarcely possible that any part of the generative system should be so modified as to produce precisely the same secretion in opposite sexes. Nor, on investigation, does any part of the generative apparatus appear to be wanting. Clearly, theory the first is not correct.

Theory the second, although nearer to the truth, is also open to fatal objection, for in no animal do we find organs or members which are not present, although very likely in a greatly modified form, in thousands of other species. Thus to hold that the explosive apparatus of these remarkable beetles is absolutely unique is probably true only insomuch as it does not appear to be present in other insects *in precisely the same form.* And we know that great numbers of insects do possess an apparatus which at least is somewhat similar in character. Thus most of the *Geodephaga* emit when handled a volatile and evil-scented fluid, not only from the mouth, but also from two small glands situated near the tail—just the region, it will be noted, in which lie the secretory organs of the *Brachini.* And some of these can eject the liquid in question to a distance of several inches. The well-known Musk Beetle (*Cerambyx moschatus*) has under exceptional conditions been known to do the same. Ants, again, expel formic acid when annoyed, and cause considerable pain and irritation if the face be held near to a disturbed nest; and some of the *Hemiptera* possess a somewhat similar power. Thus it would seem that the explosive nature of the Bombardier's discharge is merely due to the fact that the liquid which it secretes is of a more volatile character than usual, passing at once into vapour when expelled instead of evaporating by degrees. And so we have the key to the mystery.

FLINTS.*

PROFESSOR JUDD said that on that evening he proposed to speak to them concerning the uses to which flints could be put. It must be confessed at the outset that the uses to which flint could be put at the present day were greatly restricted as compared with those to which it had been put in the past. At the present day they sometimes employed flint as a road-metal, and for this purpose, though it answered fairly well, yet it was generally inferior to many of the hard igneous rocks like the well-known dhu-stone employed in the London streets. Flints were sometimes ground and reduced to powder, the powder being employed in the manufacture of glass and porcelain. There were a few gentlemen of dandified manners and conservative instincts—he did not mean politically—who preferred to use a flint and steel mounted in silver rather than the ordinary wax vestas and fusees employed in lighting pipes and cigars; and, lastly, muskets with flint locks are still prepared for somewhat unsophisticated savages, though the most unsophisticated savages of all were supplied, it is said, with muskets without touch-holes. Among savage nations flint was still largely employed for many purposes. But in nations where the arts had become known, the use of metals had to a very large extent displaced the use of flint and other stones. Among savage nations, however, flint and similar materials were constantly employed either for obtaining fire or for making tools and weapons.

Now, let them inquire for one moment what were the properties of flint which enabled it to be used in that particular way. These properties, which he had already referred to in a former lecture, were, first, hardness, which enabled it, when struck with pyrites or steel, or any hard substance, or even with another piece of flint, to emit sparks, and also enabled sharp flints to be used for cutting purposes; but with this hardness was combined a certain amount of toughness, so that it preserved a sharp edge much longer than a piece of glass or similar material, which was sometimes employed for the same purpose. Most remarkable of all was the conchoidal fracture to which he had called attention, which enabled fragments to be struck off, having the remarkable form of flakes. They would recollect what he said about flakes, with their bulb of percussion, and which enabled them to be trimmed so as to form weapons and tools of very definite form. Then there were two other properties which had some influence upon flint. First, the porosity; the porosity of flint allowed water to be absorbed and to be driven off by the ordinary drying process; so that flints were sometimes moist throughout and sometimes dry, and their other properties changed with the quantity of water they contained. Lastly, they had this important property, that flints, although, geologically speaking, they withered away, yet, spoken of historically, they were among the most unchangeable of things; so that, whereas weapons of iron and bronze, and even gold and silver, had perished, articles made of flint were almost imperishable, though even many of these worked flints could be seen on the exposed surface to be undergoing the first stages of decay, such as the flint exhibited, which had been covered in one position, where the original black surface was preserved, and on the other side there was a thin white coating, due to disintegration. Now, perhaps he ought to mention that different examples of flint exhibit very great variations in the degree to which they possess these several properties. Some flints differed greatly from others in their uniformity and fineness of grain. There were some flints which were wonderfully uniform in texture throughout their mass. These lent themselves to being fashioned in the most beautiful forms, whereas there were others which showed great irregularities in grain. In one part the structure was fine and in another part it was coarse, and thus they did not lend themselves to be fashioned with the wonderful beauty that they would see that certain flints were susceptible of acquiring. Now let them inquire what were the methods of making and using objects of flint and other similar stones; and the methods employed both in making and using flint weapons could only be judged of by studying similar weapons used by savage tribes at the present day. In many countries the use of stone was still common. In Australia, among savages there, and in the South Sea Islands, the use of metals is unknown—the art of extracting metals from the ores is quite unknown, and if they used metals at all, it was only metal which had been derived from the white man. As a rule their weapons and tools were all fashioned from stone. They had, however, sometimes an opportunity of understanding how the ancient weapons and tools were used by the early people who made them, for occasionally, as in peat mosses and similar situations, they might find the handles or the attachments of the tools actually preserved, and they might study the manner in which they were used.

Let them examine first the methods which must have been employed by the ancient workmen in fashioning the tools and weapons which they employed. With regard to those weapons and tools, he might mention that they sometimes used ordinary flint-pebbles, masses of flint which had been washed out of the chalk and rolled into pebbles. These were generally of a brownish, reddish,

* Sixth Lecture to Working Men at the Royal School of Mines.

or yellowish tint, while the tools which were made from the chalk were black or grey. Here, for example, was a most beautiful specimen of flint, where they could see a pebble had been taken and by a few dexterous blows had been made into a weapon. This came from Herne Bay, and they would see by a drawing on the wall, that the instrument probably was somewhat more pointed originally—that the point had been broken off, and that the instrument was then thrown away. They sometimes found clear indications that after an instrument of that kind had been blunted a fresh point had been given to it by chipping, but in time that wore out, and then the instrument was thrown away and a new one made. Such instruments as these were reduced to the form which they now bore by a few dexterous and smart blows, which, administered in a proper direction, would take off flake after flake, reducing the flint to the particular form exhibited. Much depended upon the skill with which the work of taking off the flakes was done, and doubtless, as at the present day, there were skilful workmen and unskilful workmen; some of the instruments made being of a very rude character, while others were very beautifully fashioned. In other cases a good black flint was selected—a flint taken from the chalk. They might sometimes see a part of the white coating which characterised flint in chalk still adhering to a part of the flint, as in the specimen from Herne Bay, and in the instrument found in London, which was preserved in the British Museum. At other times they found that masses of flint which had received a somewhat definite form by a few sharp blows taking off flakes, had been worked up in the most beautiful manner by further treatment. Here, for example, was a flint-knife, or scraper, which had been first roughly shaped by a number of blows. That specimen was from Denmark. It had been made into its present form, and teeth had been produced along the edge of the mass. The way in which those teeth had been produced was not by percussion, as the general outline of the flint had been produced, but, judging from the way in which flints arrows and similar objects were made by the Exquimaux and Indians of the present day, a somewhat different mode was adopted. If the flint was fashioned by hard blows and then a hard substance was pressed against it, little flakes might be made to fly off, and a number of delicate flakes might be taken off by pressure, and thus a perfect form be produced, especially the beautiful serrated edges which characterised some of the weapons. A diagram of one of the flint flakers used by the Esquimaux was shown, and the handle of this flaker consisted of a piece of very dark-coloured ivory, which was largely found in the Northern Hemisphere; while the tool itself consisted of a piece of the horn of a reindeer, which was used on account of its extreme hardness. This was fastened very securely by a sinew to the piece of ivory which served as a handle, and then the sinew contracted and held the piece of reindeer-horn firmly. With that weapon the Esquimaux could be seen to take a flake off a flint and work off little flakes from the edges until they produced the beautiful serrations which characterised some of the well fashioned articles in flint like the arrow-heads. How beautiful those objects could be made by this method of flaking could be seen from diagrams and specimens show. Lastly, when the very best flints were required, mines were opened in the chalk strata. Very rude mines they were, of course; they were really great conical holes which were made into the chalk leading down into a particularly good bed of flint, and carefully selected beds of flints were capable of being worked with very great care, first by chipping, and then by flaking, until most exquisitely beautiful articles, such as those exhibited, were produced. There was a wonderful variety of fashions in the different types of these instruments used in different places. On a diagram was shown a curved knife; also various forms of spear and javelin-heads; also a few of the variety of types of arrow-heads, which were made by those methods. With regard to the determination of the methods employed, they depended upon watching savages like the Esquimaux and the Indians at work; and travellers who had spent much time amongst these people had given them an account and showed clearly how any such work was being done now; and doubtless the work done in the past was effected by very similar men. Some persons by studying these various objects had learnt to make flint implements. His friend, Dr. John Evans, the well-known antiquary, who had devoted a great deal of time to the subject, and had, perhaps, the finest collection in the world, became a dexterous worker in making flint-instruments; and he remembered how the late Sir Charles Lyell was much interested in the making of the instruments and in all questions bearing on the antiquity of man. Dr. Evans sat beside a workman who was making one of these objects, and carried away every fragment of the flint in his pocket for the purpose of study. Others had worked pieces of flint for less worthy objects, like the celebrated Flint Jack and other forgers in France, who had worked in the same way as the old workmen; instead of using old stone hammers, they used hammers of steel, however, and they managed to make flint instruments in this way. It had sometimes been suggested that perhaps all the instruments were forgeries, but that was as unlikely as that all coins should be bad ones. If there had been no true coins, he did not suppose that makers of base coin would have arisen; but as a matter of fact there was generally no difficulty in distinguishing the spurious from the real article. The real articles had a peculiar lustre and feel which those who had studied the implements got to know perfectly, and they often had peculiarities which no forger, however cunning, could impart to them; and moreover, these flint implements had been found again and again by persons whose testimony was unimpeachable. There was not the slightest doubt there were many of these genuine flint implements. What he had with him were genuine, though there were forged ones, just as there were base half-crowns and sovereigns.

Let him now say a word about using those flint instruments. To a certain extent the mode in which those implements were employed in ancient times was conjectural, but it was not wholly so, for they found in modern savages so many implements of like forms that they could not doubt that they were similarly employed in the past. Among the oldest flint implements which had the greatest interest for them, they had several well-marked types. There was first the long pointed type, of which there were drawings of three specimens on the wall. They were of large size, and in regard to the way in which they were used there might be some doubt. It had been snggested that in many cases they were employed as ice chisels. He would point out to them that the climate of this country was formerly much colder than it was at present, when these people lived here, and that they probably lived by fishing, as the Esquimaux did in the present day. In that case implements of this kind would be very useful for chopping holes in the ice, in order to let down a line to get at the fish. Such instruments might easily escape from the grasp of the person and drop to the bottom of the water, and that might account for the fact that that type of instrument was especially common in gravels, where they had sometimes been found in considerable numbers. But in some cases there could be little doubt that these implements were fixed in handles and served as hatchets or weapons, and skulls and other bones of animals had been found actually perforated with those implements, the implements sticking in portions of the skull. Another use to which an implement of that kind could be put was splitting open bone and taking out the marrow, and in many cases great heaps of those bones, all carefully split by sharp instruments of that kind could be found. Then they had another type, which was found with these types — the ovoid type. They were generally much smaller than the others. The use to which these were put was also problematical, but it had been suggested, with great show of reason, that in many cases they were used for scraping skins, and that such scrapers were constantly employed at the present day with or without handles. There were many examples. Here was a specimen of the scraper fixed into a wooden handle, and it was used for dressing skins. The same sort of implement was largely used by the Esquimaux and many other people. Lastly, they might have simple flakes more or less dexterously struck off, which were employed for cutting pieces of wood, or bone, or other articles, for which purpose they were very effective. Passing from those rude and simple types, they found knives, either straight or curved, often with their edges dressed in the most beautiful manner. They found spear-heads, and javelin-heads. Then they had the wonderful variety of beautiful objects known as arrow-heads. From those types they passed to the forms which were very ornamental. Sometimes after an instrument was made, it was beautifully ornamented. Here was one ornamented with grooves, and another ornamented by very careful and elaborate chipping. It might be surmised that many of these were made more for show than for use; they were emblematical rather than useful weapons. They were like the maces and swords of state which were borne before Royal people and Lord Mayors, and such great folk, which were not employed for knocking people down or stabbing them. Next to chipping an ornamental surface to the objects, they found that the grinding and polishing of implements by sand and similar materials was practised by the use of sand and water and rudely chipped implements. Then they might have grooves cut through their crown, so as to allow the handle to be fitted more firmly; and in other cases holes were drilled right through the tools. In these cases the hole was probably produced with very great labour by means of a pointed stick used with plenty of sand and water, and worked after the fashion of a centre-bit; in that way a hole could be driven through the hardest stone. This, of course, would take a long time, but savages generally had plenty of leisure. Now a great number of other weapons and instruments might be mentioned as being made of flint or similar material. There were pieces of flint chipped so as to serve best for striking lights, and these strike-a-lights were made in the earliest times, as they were made quite down to within the memory of some of those present. Strike-a-lights were most probably used first with iron pyrites or other pieces of flint, and till quite recent times they were employed with the steel and tinder box. Besides this, flint and other materials were used to make hammers. Here were some of the hammers which were actually employed. By successive blows flakes had been dexterously struck off, and then the core was thrown on one side when a sufficient number of flakes had been taken from it. Stones were found slightly rounded by a few blows so as to serve probably as sling stones, others as heads of clubs sometimes, and sometimes for attaching to nets to sink them to the bottom; sometimes the flakes were set in great masses on blocks of wood so as to form threshing instruments. In Asia Minor at the present day sets of flint flakes could be purchased. Then there were pestles and mortars, a large stone with a curved surface and rubbers, by means of which grain could be rubbed down to the condition of flour; and lastly, there was no doubt that the earliest surgical instruments were made of these flints. Long after flints and similar materials had ceased to be employed for other purposes they were used for certain delicate surgical operations, and one could easily see that a beautifully clean piece of flint was very preferable to instruments made of bronze such as were employed by Eastern surgeons at the present day. Lastly, he might mention that some of the more delicately struck-off flakes were employed for cutting out needles, harpoons, and other articles, and in the use of delicate fragments of flint they saw the origin of art. The drawings and sculptures which had come down to them in ivory were worked by sharp fragments of flint, or else carried out in the manner illustrated. Here they saw the origin of art.

Now with regard to the mode of fastening these implements to their handles. Sometimes the implements were clearly inserted in a hole in a piece of wood that served as a handle; a hole was made into the handle, and the flint driven into it, and every blow served to fix it more firmly. In other instances, as the wood would wear away, the stone instrument was fitted into a socket of bone and the bone fixed in the weapon handle. Sometimes bone only was employed. From these simple cases they had others where a stone implement was tied into the bone or weapon handle either by means of a thong made of vegetable fibre or the skin of an animal, as they could be wetted and dried, and in drying they often held the mass very firmly in its place. In other instances, as in Western Australia, masses of gum or resin were employed and melted round the natural flint or other stone. In a diagram was shown a handle fastened to a scraper by means of resin, and sometimes both cords and resin were employed. In other cases there was a groove cut and the handle pressed forcibly into it, or sometimes the handle was twisted round and fastened to a straight handle, the whole being bound strongly together; and, last, they came to a case where holes were drilled to hold the handle. In some cases they had actually found the workshops where the flint implements had been made. They occasionally found, sometimes in an old pit where quantities of gravel or other materials had been dug out, and sometimes in other places where these remarkable tools were formed, the flakes which had been struck off in fashioning the instrument, and they found the cores from which large flakes had been struck, and sometimes long flakes which could be fashioned into delicate instruments. Then they found great blocks of stone, generally with a depression in them, on which these masses were rested while the blows were being struck which separated the flakes; and in one case a very ingenious worker, Mr. Spurrell, had contrived by picking up pieces of flakes at a certain spot and fitting them together to reconstruct a rough chalk flint out of which a spear-head had been made. In the centre was a cavity, evidently the place where the tool was originally, the flakes which were lying about on the floor were actually the flakes which were struck off in making the implement. The implement, of course, had not been found, but enough of the flakes had been found to show the general character of the rough flint out of which the implement was originally made.

Now, the study of these flint instruments had led them into very interesting results with respect to the history of the human race. It was certain that the age of man in Britain and in other countries went back very far indeed beyond the period covered by history, or even by tradition. Flint implements which had undoubtedly been made by man had been found in situations and with surroundings which left no possible doubt that they were of enormous antiquity, an antiquity of many many, thousands of years, though they could not give their actual date in years. These implements were found sometimes in the gravel of rivers, like the gravel of the Thames Valley, not only the gravel in the present river, but at a greater elevation than the present river—50 and 60 and 70 feet above—where the river formerly worked before it cut down its bed to the present level. They found such instruments in the old caves which were sometimes inhabited by these men, and they also found the remains of animals which had either been washed in or had been carried in by men who had killed them for their prey, and with some of those skeletons of animals not living now in this country were found these remarkable flint instruments, the whole being covered up by a layer of stalagmite, and it was possible for an investigator to break open these stalagmites, and find concealed below, the bones of these animals, mingled with weapons of men who lived at the period when the caves were inhabited. Besides these proofs they had raised beaches—that was sea beds, which by the movements of the land were now far above the sea level—they found in those remarkable refuse heaps, or *kitchen middens*, as they were sometimes called, or shell mounds, many of the relics, and tools, and weapons made of stone employed by these ancient people who lived almost entirely upon shell-fish, with such game as they were able to kill with their rude weapons. Now in the remarkable lake dwellings of western and other countries, of which they had examples in Central Africa and New Guinea, at the present day, in peat mosses and other situations, there were many deposits containing these remarkable flint instruments.

And now he must point out to them what were proofs of the antiquity of these objects. The proofs of antiquity were of two kinds. First of all it was clear that in many cases great physical changes had taken place since these objects were deposited in the situations where they now found them. In many cases, as he had already pointed out, the rivers which had flowed at these spots, had worn down their beds 20, 30, 40, 50, and 60 feet below the level at which they must have flowed when these instruments were deposited in the midst of the gravel. In other cases, as, for example, the flint instruments which had been found along the shores of the Solent and in the Isle of Wight, they had evidence that when these men lived, and used implements of that kind, the Isle of Wight was joined to the mainland, and then all the wearing away which first took place by the river which ran there, and then by the sea which effected the separation of the Isle of Wight from the mainland, all this action had gone on since those implements were lost in the bed of that ancient river. Moreover they had clear proof that the climate had changed, he would not say for the better, but it was somewhat warmer now than when these men lived there. The second proof of the antiquity of these objects was found in the fact that they were associated in such a way with the remains of various animals, some of which were actually extinct, and had died out altogether in the world, and others no longer existed in this country, but in distant countries, such as the hairy mammoth, which does not live at the present day. These, with reindeer and many other animals with curious shells, which were found in the rivers at that period, though not living in this country now, and various forms of vegetation—all these associations indicated that man was living contemporaneously with these curious forms of life. That the antiquity of these objects was very great could not be for one moment doubted, though it was quite impossible to assign the age of each object in years. It must be measured by many, many thousands of years.

Let him just recall to their recollection some of the results of these interesting studies, carried on concerning these wonderful flint instruments. He would not waste time by insisting upon the fact that these objects were really of artificial origin. He might as well try to argue that his watch got into his pocket by chance, and that it was not made by a watchmaker, as that these beautiful objects were not made by men with a definite object. The study of these interesting objects showed that there was a regular succession amongst them; that many of the oldest objects contained proofs of antiquity which were most striking. Thus associated with the remains of animals of a kind which were quite extinct, they had very rude and primitive types, and as they came down to more recent times—in which the evidences of the change of climate, in the inhabitants of England, the wild beasts living in England, and they approached nearer to our own time, they found other types employed. The oldest and simplest types were those which were classed as older palæolithic, and these older palæolithic were the types which were employed by men who lived here in very remote times. In that variety the implements had generally long spear-headed and rounded forms, and simple flakes, which were employed for various purposes, also occurred. Of the men who fashioned these instruments they knew very little. The instruments were so simple in kind, and were so seldom found associated with other objects which would throw light upon the nature of the avocations of the users of these instruments, that all they could infer was that they were hunters and fishers; probably, by their superior numbers and cunning, they waged successful warfare with some strange animals that lived in the country, including the curious woolly elephant, the hippopotamus, the lion, the bear, and other animals. That they fished in the river was exceedingly probable, and it was also certain that the climate was colder, and what would perhaps strike them as improbable, even wetter than at present. The next or reindeer period was characterised by the fact that people made weapons of much more delicate and varied types. At this period the reindeer lived abundantly in this country, though now it had emigrated far to the north. The climate, as they might well imagine, was probably colder then than at present, and they found that the men of that period exhibited greater skill in the making of weapons. They made stone implements which were very carefully and often delicately fashioned, and were of a much more varied type. Amongst the instruments made there was a much greater variety of type than in the older palæolithic time. They found that with flakes of flint they carved various articles like needles and harpoons out of pieces of bone, and they even attempted art, for ornaments and drawings were actually found in some cases which were made by these people. But, nevertheless, they were very primitive people indeed, for it was very clear that amongst them pottery was quite unknown, and they seemed to have had no dogs or other domestic animals. In their mode of burial, evidence was obtained that superstition, the mother of religion, as it had been called, existed, and, as they found with the bones of early people who had been buried, the axes, and treasures that belonged to them, they might infer that they had some idea of the future life in which those objects would be of use to them. There was also an indication that human sacrifices were offered in these periods, for in many cases the number of bodies laid round a central one, would seem to indicate that slaves and attendants were slaughtered to serve as attendants to them in another world, as was the case with savages in the present day. Most of them were hunters, and they were probably more skilful men than those of the palæolithic time, and there was evidence that they were not cannibals. Even a greater time seemed to separate these palæolithic men from the neolithic men, and a great advance seemed to have been made in some forms of civilisation in the interval between palæolithic and the neolithic periods. The implements employed in the neolithic time were of the most beautiful and exquisite workmanship. They were fashioned by the process he had endeavoured to describe that evening, and in addition to that it was found they were even rounded to a smooth surface, and those surfaces were sometimes beautifully polished. They were sometimes perforated so as to be attached to handles, and sometimes they had most striking ornamentation worked on the surface. There were indications that for the purpose of obtaining the best materials, for making these stone implements, mining operations were carried on, sometimes with a fair amount of skill, and that something like commerce was carried on for highly-prized materials were carried to enormous distances—half across a continent—in order that the much-coveted materials might come into the hands of persons who had articles to exchange for them. In this neolithic period there was evidence that a very rude kind of pottery was employed; that the dog and other domestic animals had been tamed and brought into use, and here was a primitive but useful kind of agriculture carried on. In this period the bodies were generally buried in a crouching position, and he was sorry to say that there was evidence that was a going backward in one respect, for cannibalism was certainly prevalent, though they might hope that it was occasional rather than habitual. The people of that period seemed to have been short in stature, with oval skulls and black hair. It was even possible that ancient people, known as Baskes, which were found in Spain and in the mountain regions of Northern Africa—that these people were descendants of some of these northern men. It was possible, seeing the similarity and habits of many of the Esquimaux tribes in Greenland and British North America were so similar to the habits of the men of the newer palæolithic period, that the Esquimaux were the direct descendants of the newer palæolithic men. But since metals were invented the use of stone rapidly declined, though they must recollect that in many parts of the world people had not got beyond the stone-age. They still used the rough or sometimes more carefully prepared weapons made of stone. First, perhaps, iron which was found as a meteoric production and was employed for implements. Then copper, which was found native, was used. Next, man learned to make an alloy of copper and tin, and then they had an age of bronze, which was succeeded by the period when iron came to be very generally employed, which was the iron-age, and he supposed that now they lived in the steel-age. But even now, in this steel age they had the modern survival of the use of flint. Some present could recollect the use of the old tinder-box with strike-a-light, and in mines not very long ago a steel wheel working against a piece of flint was made to emit sparks, was all the light the colliers had to work by in very fiery mines. Flint locks, and guns, and pistols were employed down to recent times, and they were still made at Brandon in Suffolk, where the trade of flint knapping was carried on at the present day. They might find in the museum many illustrations of how flints were worked up from the cores at Brandon, and fashioned into various kinds of flints for muskets. It might be that these old workmen at Brandon must be regarded as lineal descendants of the old neolithic, and even of palæolithic workers of flint. They had seen that night how the study of these artificially-worked flints carried them back beyond—very, very far beyond—the periods covered by all histories—even the histories of Egypt and China. But what of the study of the flint itself? As they stood on the sea-shore, the meanest pebble that they picked up and carelessly flung into the water, might reveal to them a story which, if they had really read it aright, must send their thoughts in ever-widening circles outward across the ocean of knowledge towards that mysterious horizon which divided science from the unknowable.

Reviews.

Transactions of the County of Middlesex Natural History and Science Society. Session 1887-88. (London: Mitchell and Hughes.)

These transactions contain no small amount of interesting matter in a paper on "The Chemistry of London Clay." Mr. W. Mattieu Williams points out that the peculiar character of clays is that they contain not merely silica and alumina, more or less pure, but combined water, as distinguished from moisture. If such combined water is once driven off by heat the clay loses its plasticity, which cannot be restored by mechanical admixture with water.

Mr. Sydney T. Klein, F.L.S., F.L.S., gives an interesting paper on *Ephestia Kühniella*, a lepidopterous larva, which recently appeared at the East End of London, and destroyed or spoiled many hundred pounds' worth of flour.

After fumigations had been tried in vain, and after poultry became over-satiated with gorging, the pest was overcome by the appearance of a swarm of tiny ichneumons.

Professor Flower, F.R.S., in a paper on "Horns and Antlers," points out the difference between the deciduous antlers of deer and the true, permanent horns of oxen and sheep.

There are further papers on the "Position and Prospects of Electric Lighting in London," by W. L. Carpenter, B.Sc.; "Fossils of the Flint," by Mr. G. Barraclough, M.R.C.S.; and the "Water-supply of Middlesex and the Metropolis," by M. H. Hughes, C.E. In this paper the author attempts to defend the prevailing and inequitable system of charging for the water-supply not in accordance with the quantity consumed, but with the assumed ratable value of the premises occupied by the consumer. We do not object to the rating principle as regards the incidence of other local burdens, but in such cases no other way is possible. It must be remembered that wherever water is furnished by a company, with rare exceptions, the supply is intermittent, and where it is in the hands of a local authority it is constant.

Mr. C. Rousselet gives a paper on "Some Methods of Collecting and Keeping Pond Life for the Microscope," and Mr. T. Blashill contributes a memoir on "Miniature Earth Pyramids in the Clay at Hampstead."

First Yearly Report of the Meteorological Observations on the Sonnblick.

The Sonnblick Observatory is situated in 47·3° N. lat. and in 12·87° E. long., and at the altitude of approximately 10,000 feet above the sea level. The Director of the Observatory, Dr. J. Hann, has issued a complete conspectus of the observations made at this lofty station from October, 1886, to September, 1887. The results merit attention, not only because the Sonnblick is the most elevated meteorological station in Europe which is completely equipped, but because the observations at other stations are in general desultory and imperfect.

The highest meteorological station in the earth is that of Pike's Peak, in Colorado (about 14,000 feet), but as yet it has furnished merely a few mean determinations of atmospheric pressure and temperature. The same must be said of the station on Mount Washington, though these two observatories have been instituted respectively in 1872 and 1873. The observations at the French stations on the Puy de Dôme (4,890 feet) and on the Pic du Midi (about 9,000 feet) have not hitherto been used for deducing general conclusions.

The mean values of the atmospheric pressure for the whole year are 520·42 millimetres at 7 a.m., 520·85 at 2 p.m., 520·95 at 9 p.m., or a mean of 520·74. The temperature is at 7 a.m. −7·4°, at 2 p.m. −6·1, and at 9 p.m. −6·9°, or a mean of −6·8°. The absolute moisture is 2·8, and the relative is 93. The yearly mean of the extreme atmospheric pressures shows a maximum of 531·7 and a minimum of 501·1. The greatest barometric variation on the Sonnblick is 30·6, as against 36·8 millimetres at Salzburg. The extremes of temperature are 8·0 and −29·2°, the range being 37·2°, whilst at Salzburg the corresponding values are +30·4 and −16.5°, with a range of 46·9°.

The progress of the decrease of temperature with increasing elevation, and which will, to a certain extent, hold good for the entire Alpine region, is—

	Elevation.	Temperature.
Sonnblick	3095	−6·8°
Säntes	2465	1·8
Obir	2040	0·3
Schmittenbache	1940	1·1
Schatberg	1776	1·8
Wendelstein	1730	1·9
Hohmsalzberg	1490	3·8
Gastein	1020	5·3
Rauris	940	4·9
Niederkirchen	850	5·7
Zell	750	5·6
Ischl	467	7·6
Salzburg	428	8·7

The Sonnblick Observatory affords an opportunity of observing the decrease of atmospheric warmth on ascending, as in the neighbourhood there are numerous stations at different heights above the sea-level. The decrease of temperature with increasing height takes place in a sinple arithmetical series only in summer. In other parts of the year it decreases in an accelerated proportion. The change is most irregular in winter, when there even occurs a rise of temperature on proceeding from the bottom of the valleys of Pinzgau to a certain relative height. A very striking instance of this phenomenon was recorded in January, 1887. The temperature increased up to an altitude of 840 metres above the valley (1690 metres above the sea). At this height it became stationary, and then decreased, so that at 2,520 metres above the sea-level the same temperature as at the bottom of the valley.

The observations on the Schmittenbache and at Obir, if collated with those taken on the Sonnblick, give the following values for the decrease of temperature for each 100 metres of elevation in the atmospheric strata between the elevations of 2,000 and 3,000 metres: in winter 0·58, in spring 0·66, in summer 0·77, in autumn 0·72, and in the entire year 0·68.

If the differences of the mean monthly temperatures on the Sonnblick and at Säntes, Schmittenbache, and Obir are used for calculating the mean normal temperature, we find for the Sonnblick −6·8, whilst at Säntes it is −1·8. The mean normal temperature on the Sonnblick, as calculated, is very probably in winter −13·5; in spring −8·6, in summer −0·1, and in autumn −5·4. These points will be better realised if we remember that the mean yearly temperature on the Sonnblick corresponds to the isotherm on the earth's surface, passing through the middle of Spitzbergen, the southmost of Novaj Sembla, and in Asia from Obdorsk to Ochosk. The mean winter cold on the Sonnblick is as great as in Orenburg; the pring resembles January in Central Russia; the tumn is like the same month at Wilna. But the sum er has a mean temperature lower than has ever been r gistered at the same season in the northern hemisphere, and such as may, perhaps, prevail only in the higher southern latitudes. The mean variability of temperature from day to day on the Sonnblick is smaller than it might be expected. Great changes do not occur; the greatest fluctuation amounted to 11 degrees, and took place between February 6th and 7th, whilst at Rauris there was a change of 14·8° from January 8th to 9th, and of 11·7° from January 4th to 5th. Comparison with a number of other stations proves that the progress of these changes of temperature is entirely different at different stations. Thus the magnitude and the frequency of the rises and falls of temperature must rank among local phenomena. The lowest mean variations of temperature on the Sonnblick is in January and May, whilst at the same time great fluctuations occur at Rauris and Ischl.

In winter and autumn the cloudiness is greater in the low grounds than at the high Alpine stations. In spring and summer the summits are more overcast. In spring, summer, and autumn the frequency of sunshine on the Sonnblick falls earlier in the day than in the lower grounds. At this elevation in summer the greatest frequency of sunshine occurs between 8 and 10 a.m., and then rapidly decreases. This is evidently due to the influence of the ascending air current, which forms clouds and mists on the summits as soon as the valleys become heated. On the heights the afternoon sun is therefore a cause of cloudiness, whilst in the low grounds it dissolves the clouds.

On the Sonnblick the predominating winds are the south-west and the north, whilst in the valleys the west and north-east predominate. Calms are very rare. In the valleys calms occurred in thirty-five per cent. of the observations, but on the Sonnblick only two per cent.

RATIONALITY IN THE LOWER ANIMALS.

We often hear discussions on the question whether or not the lower animals possess any share of reason, or, in other words, whether they differ from us in degree or in nature? The affirmative side is taken chiefly by working naturalists; those who make actual observations on our "poor relations" in the woods, the fields, or in default in menageries. The negative view is upheld for the most part by metaphysicians, who convince themselves on *à priori* grounds that "brutes" cannot reason, and who wave aside every appeal to facts as an impertinence.

We think that a novel argument may be drawn from facts which are admitted without dispute, but the bearing of which has not been fully recognised.

It may at the first sight appear extremely paradoxical if we adduce superstitious fears, in man or beast, as a paradox, since most persons would at once pronounce superstitions as a proof, more or less complete, of irrationality. But yet we shall see, on close examination, that in the entire absence of reason superstition could not exist.

Let us suppose Giles the ploughboy, or any other similarly uncultured individual, is plodding his weary way homewards after his daily toil. He sees a field-mouse hurry across the path, or a crow stalking along the newly turned-up furrows. He will feel no surprise and will take no more notice of either animal than, perhaps, to fling a stone at it. Wherefore? Because the fact that living animals are capable of voluntary movement is part and parcel of his own daily experience, and because he has always heard them spoken of as capable of such movement. But what if he should see an old bone, a stick, or a stone, in short, any lifeless object moving regularly and continuously along a level piece of ground, and suppose he should be unable on looking more closely to detect any agency by which it was pushed or drawn? His curiosity would be unpleasantly roused; he would feel uneasy, and if he saw no chance of trickery he would suspect the interference of some supernatural, or at least extra-natural agency. But why should he thus feel disturbed in mind? Because he has in his mind a rough notion of a certain order of nature, any departure from which strikes him at once as uncanny. His life experience and the traditional experience of his parents, neighbours, and associates tell him that *only* living animals are capable of spontaneous movement. If, then, he sees such movements on the part of a portion of lifeless matter he feels that the boundaries of his experience are transcended, and that he is in presence of unknown forces. His idea of an order of nature is the key to his feeling of mystery and awe, or, if we prefer the expression, to his superstitions. Were he incapable of forming such a concept all phenomena would seem to him equally matters of course, and he would be incapable of the feeling of mystery.

Now, this very power on the part of man of conceiving of an order of Nature, of a normal course of things, has always been accepted as evidence of human rationality. It presupposes not merely the power of observation, but of generalising from the facts observed. If, therefore, we find in the lower animals instances of superstition, of uneasiness apart from the feeling of danger, we are driven to the conclusion that they, too, conceive of a normal order of things, that they recognise any departure from such order, and are, therefore, in so far rational.

Some of the most striking instances of brute superstition have been observed in dogs. We were once witness to an instance of this kind. A dyer in a northern town had a very white fleecy poodle, and from some freak he dyed the animal a rich, full shade of magenta. As he was going along the street of his village, attended by the poodle, a notoriously pugnacious terrier ran up to accost the stranger, perhaps in peace or perhaps in war. But as soon as he came near enough fully to recognise the un-dog-like hue of the poodle, he stood to gaze a moment and then fled as fast as his legs could carry him. His notions of the fitness of things had received a rude shock.

We once knew of a dog named Tab, by no means deficient in intelligence, who was always greatly alarmed at a thunder-storm, so much as to be rendered positively ill. It is difficult to ascribe this fright to the dread of bodily injury.

Much more striking instances of this kind are on record. A very vicious terrier was once just on the point of attacking a performing monkey, when the latter took off his cocked hat and saluted him very gracefully. The dog at once bolted under some shrubs and would not reappear until the monkey and its owner had left the premises. Such facts which have been collected and recorded by Dr. G. J. Romanes are utterly inexplicable unless we admit that the dogs have deduced from their experience some rude idea of an order of Nature, of which the instances given are violations. In all probability such cases show that brutes are able to sum up their observations in the form of general propositions.

The First Appearance of Germanic Tribes in Europe.—According to Montelius (*Archiv. fur Anthropologie*) the immigration of these tribes took place towards the end of the Stone epoch, about 4,000 years before our era. He supposes that they came along the cost of the Black Sea, and penetrated into Gothland by way of Denmark.

THE UTILITY OF BEES.

(*Concluded from p.* 597.)

EDMUND AGASSIZ, a bee-owner of Switzerland, writes thus to *La Nature* :—

'ith us no one questions the utility of bees for en- , the fecundation, and in consequence the pro- eness, of fruit-trees in general. As for the grain I have never remarked that the bees visit the t, at least in our country. At the time when the is in bloom other flowers supply an abundant sion for the bees, which always visit by preference plants which secrete most nectar. It is the same the vine. With us the bees do not visit it, or when the fruit is very ripe. Still, I have seen them nally visiting the vines, but finding little, they one elsewhere.

me years ago I read in a small agricultural journal r from a person who complained of having no n his trees, and foolishly ascribed this defect to the which he thought exhausted the trees by sucking uices. Now, the spring of that year was exceed- unpropitious; the blossoming of the trees had uined by cold, wind, and rain. The bees had not able to fly about, in consequence of the bad er, so that they could not fairly be blamed for the ef. Fertilisation had failed, not only because the not been able to visit the drenched and im- ded blossoms, and the wind which, in a assists in the work, though in a hap- could not convey the clotted and ne pollen from one flower to another. No one e trouble to reply to this correspondent.

any case the culture of bees cannot be too much aged. Here in Switzerland agriculture is carried to t height, especially rational apiculture with im- hives. We have many societies, lectures, and ions. I shall at the season make further observa- s to the visits of the bees to the wheat when in "

following passage from the *Australian Times* es consideration :—

over rarely produces fertile seeds in New Zealand, e the humble-bees necessary to its fecundation t found there. Mr. Douglas, of Motiti, has just ed a nest of humble-bees in the hope that these may prove a remedy for the situation. Darwin ed the following striking proposition: If we o gather fertile seeds of clover and of pansies, ist have cats!" In fact, humble-bees are necessary e fecundation of these plants, and as field-mice are ond of honey and destroy them, we must protect wls and the cats which kill the field-mice. Mr. A. llace, in his grand work "The Geographical Dis- ion of Animals," informs us that the entomological y of New Zealand corresponds to its botanical y. An analogous fact is observed in the Gallapagos s, which are still poorer.

h reference to the remarks of M. Edmond Agassix, l above, that bees do not visit the vines, at least in erland, M. Jobard, of Dijon, writes that in the Côte the facts are very different. This is shown by the llowing letters, Mr. Henri Maitre, of Chassagne, in ôte d'Or, writes, "Another proprietor and mysel assagne, are the only persons here who keep bees. he arbours and walls of our gardens are each year d with splendid clusters. They are indubitably the finest in the village, and our common friend M. Monniot can tell you if I exaggerate."

M. Furgeot, of Mersault, in the same department, writes, "I know a neighbour who has a fine hive, and his trees are generally envied for their fine fruits. The vine in his court produces large grapes, though it is considered to be of a small-fruited variety."

M. Froissard, an eminent agriculturist of Anney, writes, "I am perfectly convinced that M. Jobard is right. It is with plants as with ourselves. Their reproduction by consanguinity, if I may thus express myself, ultimately reduces every organic species to rachitism. The crossing of the pollen prevents this degeneration, and the bees effect such crossing as they gather pollen from flower to flower. I have earned, by way of amusement, 1,000 francs yearly by my eighteen hives, rationally managed. If persons of influence would take up this question they would confer a wonderful service on our peasantry."

By way of hearing all sides of the question we quote the following remarks from a work entitled "Cameos from the Silver Land," by E. W. White, F.Z.S. (London: Van Voorst): "The people of Rioja have a great horror of bees, and allow no hives within leagues of their city, asserting that they destroy both fruit and flowers, especially of the grapes and oranges." Mr. White called this "an ordinance based upon ignorance," an opinion with which we should be disposed to agree. But we should like to know the origin of this strange notion, and upon what facts, real or imaginary, it is founded.

CORRESPONDENCE.

The Editor does not hold himself responsible for opinions expressed by his correspondents, nor can he take notice of anonymous communications. All letters must be accompanied by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

COLOUR OF THE WINGS OF *CATOCALA SPONSA.*

I have heard that at a recent meeting of the Entomological Society there was exhibited a specimen of a *Catocala*—believe *sponsa*—in which the hinder wings, instead of the ordinary red, were of a rich purple colour. Can any of your entomological readers say whether this was an anomaly, or whether the specimen produced was a female, which, I am told, is very rarely to be met with? G. G.

THE UTILITY OF BEES.

I have read with much interest this article, which appeared in the SCIENTIFIC NEWS for December 14th, 1888, but cannot agree with it as regards the fertilisation of cereals, especially wheat. Mr. A. S. Wilson, after careful experiments and observations, came to the conclusion that self-fertilisation is the rule among cereals.

Cross-fertilisation, no doubt, does occasionally take place, being generally effected by means of the wind. I never yet saw a bee in a wheat-field, and I should like to know what reward they get for fertilising the wheat. E. B.

Great Malvern.

[They could certainly find pollen.—ED. *S. N.*]

ANSWERS TO CORRESPONDENTS.

L. B. B.—The experiments of Ludwig and his pupils show that a supply of oxygen is necessary to the activity of the cardiac nerve-centres. *In vacuo* or in CO_2 the heart soon ceases to beat.

DIARY FOR NEXT WEEK.

Tuesday, Jan. 1.—Royal Institution, Albemarle Street, at 3 p.m.—*Clouds and Cloudland*, by Professor Dewar, F.R.S.

Wednesday, Jan. 2.—Society of Arts, John Street, Adelphi, at 7 p.m.—*How Chemists Work—an example to Boys and Girls*, by Professor Armstrong F.R.S.

Thursday, Jan. 3.—Royal Institution, Albemarle Street, at 3 p.m.—*Clouds and Cloudland*, by Professor Dewar, F.R.S.

Saturday, Jan. 5.—Royal Institution, Albemarle Street, at 3 p.m.—*Clouds and Cloudland*, by Professor Dewar, F.R.S.

SELECTED BOOKS.

Astronomy with an Opera Glass. Popular Introduction to the Study of the Starry Heavens with the simplest of Optical Instruments. With maps and directions to facilitate the recognition of the constellations and the principal stars visible to the naked eye. By G. P. Serviss. London: Sampson and Son. Price 7s. 6d.

A Text-Book of Elementary Metallurgy, for the use of Students. By A. H. Hiorns. London: Macmillan and Co. Price 4s.

A Sketch of the First Principles of Physiography. With Maps and numerous Illustrations. By J. Douglas. London: Chapman and Co. Price 3s. 6d.

The World's Inhabitants; or, Mankind, Animals, and Plants. Being a Popular Account of the Races and Nations of Mankind, Past and Present, and the Animals and Plants inhabiting the great Continents and Principal Islands. With about 900 Illustrations, representing all the Types of Mankind, their Home and their Public Life, together with many of the Principal Types of Animals and Plants. By G. T. Bettany. London: Ward and Lock. Price 7s. 6d.

Seas and Skies in many Latitudes; or, Wanderings in Search of Weather. Maps and Illustrations. By R. Abercromby. London: Stanford. Price 18s.

A Short History of Natural Science. Fourth edition. With Corrections and Additions. By Arabella B. Buckley. London: Stanford. Price 8s. 6d.

Electric Bells, and all about them. A Practical Book for Practical Men. With more than 100 Illustrations. By S. R. Bottone. London: Whittaker. Price 3s.

On the Senses, Instincts, and Intelligences of Animals. With Special Reference to Insects. By Sir John Lubbock, Bart., M.P. With 100 illustrations. London: Kegan Paul, Trench, and Co. Price 5s.

Elementary Commercial Geography. A Sketch of the Commodities and Countries of the World. By H. R. Mills, F.R.S.E., Lecturer on Commercial Geography in the Heriot Watt College, Edinburgh. London: C. J. Clay and Sons. Price 1s.

NOTICES.

Binding Cases, Title Page and Index for this volume will be prepared, and will be obtainable in due course from the Publisher, 3, Great Queen Street, Westminster, S.W.

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METEOROLOGICAL RETURNS

For the ten weeks ending on Monday, Dec. 17th, 1888. Specially prepared for SCIENTIFIC NEWS from official reports.

	Mean Temperature.	Rainfall.	Duration of Sunshine.
Scotland, East	44·1 degs., being 4·1 degs. above average.	7·7 ins., being 0·5 ins. above average.	79 hrs., being 67 hrs. below average
England, N.E.	45·5 " " 2·9 " " "	4·4 " " 2·1 " below "	125 " " 7 " above "
England, East	45·0 " " 1·5 " " "	3·4 " " 1·8 " " "	156 " " 5 " " "
Midlands ...	44·9 " " 1·9 " " "	6·2 " " 0·3 " " "	135 " " 5 " below "
England, South	46·7 " " 2·2 " " "	6·7 " " 0·1 " " "	144 " " 8 " above "
Scotland, West	46·1 " " 3·2 " " "	13·7 " " 1·7 " above "	179 " " 46 " below "
England, N.W.	46·5 " " 1·8 " " "	8·2 " " 0·6 " below "	94 " " 19 " " "
England, S.W.	48·1 " " 2·0 " " "	11·0 " " 0·4 " above "	152 " " 4 " " "
Ireland, North	47·3 " " 2·8 " " "	7·8 " " 0·4 " below "	122 " " 26 " " "
Ireland, South	48·3 " " 2·7 " " "	10·2 " " 0·5 " above "	136 " " 30 " " "
The Kingdom...	46·3 " " 2·5 " " "	7·9 " " 0·1 " below "	132 " " 18 " " "